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NAVY PROGRAM MANAGER'S GUIDE

1985 Edition

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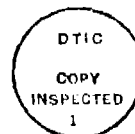
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Washington, D.C. 20360

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NAVY PROGRAM MANAGER'S GUIDE

1985 Edition



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1. Enclosure (1) has been updated to reflect current changes in the Navy acquisition process and policy instructions, particularly those due to issuance of OPNAVINST 5000.42, RDT&E Acquisition Procedures and OPNAVINST 3960.10B, Test and Evaluation. Promulgation throughout your command and field activities would be appreciated.

2. The 1985 edition is the third publication of the Guide, originally issued in 1980. Thanks to the over one hundred people who took their time to review and comment on the text. While attempts were made to incorporate all the suggestions and comments provided, some were beyond the scope of the present text. The Guide will continue to be periodically updated; therefore, your additional comments and suggestions are welcome.

3. The Guide has been rearranged so that each section is basically independent.

Section 1, INTRODUCTION, remains essentially unchanged.

Section 2, PROGRAM MANAGEMENT, combines the various discussions on the program manager and program management which were formally spread throughout the Guide.

Section 3, THE ACQUISITION PROCESS, is still basically the same except that most discussions about the program manager and program management have been moved to the new Section 2. Also, a number of paragraphs on such topics as the Acquisition Strategy, etc. have been moved to the new Section 4.

Section 4, CRITICAL TOPICS, combines the former Section 3 with some items from the old Section 2. Also, the fold-out of Controlling Documents has been revised so the information thereon is more readable.

Appendix A, SYSTEMS ACQUISITION IN THE NAVY, is new with this edition and provides the acquisition process outline which was contained in the Guide Supplement, issued in December, 1983 called "AN INTRODUCTION TO THE NAVY ACQUISITION PROCESS."

Subj: NAVY PROGRAM MANAGER'S GUIDE

Appendix B, PLANNING, PROGRAMMING AND BUDGETING SYSTEM (PPBS), is also new. It has been taken from the March 1983 edition of the Department of the Navy RDT&E Management Guide, NAVSO P-2457, Appendix H.

Appendix C, ABBREVIATIONS, was the old Section 4.



STUART J. FITRELL

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Section 1

INTRODUCTION

Section 1

INTRODUCTION

PURPOSE

The purpose of the NAVY PROGRAM MANAGER'S GUIDE is to assist the manager of any acquisition program by (1) outlining the system acquisition process, (2) identifying participants and describing their roles, (3) describing the procedures necessary to move the program from one milestone to the next, and (4) identifying possible pitfalls along the way. Rather than telling the manager how to do his job, the Guide focuses on what has to be addressed and, where possible, outlines methodologies and strategies and directs the manager to specific sources for help.*

SCOPE

The Guide covers the Department of the Navy (DON) system acquisition process, leaning heavily on lessons learned in past acquisition programs. It is not a detailed description of the specific duties of the acquisition manager as these will differ with each program. Nor is it to serve in lieu of the many official Department of Defense (DOD), Secretary of the Navy (SECNAV), Comptroller of the Navy (NAVCOMPT), Office of the Chief of Naval Operations (OPNAV), Marine Corps, Naval Material Command (NAVMAT) and Systems Command (SYSCOM) directives and instructions governing the acquisition process. It is the manager's obligation to familiarize himself** with these publications and other relevant official literature. A chart of relevant NAVMAT and higher controlling documents is provided on Figure 4-22, Section 4.

The DOD has, by policy, reduced the number of major systems that require top level management and, at this time, there are fewer than 25 Navy major systems. This GUIDE, while modeled on the well-documented major systems acquisition process, is intended to be equally applicable to less-than-major systems. The manager of a less-than-major program will have to carefully determine which portions of the relevant instructions and directives are applicable to his program. The reader will obtain the maximum benefit from this GUIDE if he has previously read Office of Management and Budget (OMB) Circular A-109, DOD Directive

* Although both the title and text of this GUIDE use the term "program manager", the information contained herein is equally applicable to less-than-major programs led by a project manager. The term program manager (PM) is used throughout the GUIDE for convenience.

** Navy policy strongly encourages the selection of the best person available for a program management position, regardless of that person's sex. However, to avoid awkward grammatical constructions, masculine pronouns are used throughout the GUIDE.

(DODD) 5000.1, DOD Instruction (DODI) 5000.2, DODD 5000.3, DODD 5000.39, SECNAV Instruction (SECNAVINST) 5000.1, OPNAV Instruction (OPNAVINST) 5000.42, NAVMAT Instruction (NAVMATINST) 5000.22, and for Marine Corps Acquisitions, Marine Corps Order (MCO) P5000.10. Anyone involved in system acquisition for the Navy or Marine Corps must be conversant with these documents.

While this GUIDE is an introduction and ready reference to the Navy acquisition process, it is not a substitute for the courses in project management offered by the Defense Systems Management College (DSMC), the Naval Material Command (NMC) Career Development Institute and the Federal Acquisition Institute (FAI). These courses, as well as the course on the Planning, Programming, and Budgeting System (PPBS) offered by DOD, are all strongly recommended.

ORGANIZATION

This GUIDE is divided into four sections: Section 1 - an overview of the system acquisition process; Section 2 - a summary of the duties of the PM and available PM support; Section 3 - a detailed discussion of the acquisition process; and Section 4 - a discussion of available management tools and critical topics that are not phase-specific.

The information presented in the first and third sections of this GUIDE is organized chronologically, paralleling the multiphase Navy acquisition process. Some of the procedural steps and areas of concern that will require PM attention occur in more than one phase; therefore, certain duplications and redundancies have been allowed to remain in the text in order to assist the PM in planning and executing his program.

BACKGROUND

A Single Policy for all Naval Acquisitions

The DON acquisition policy is the product of a long evolutionary process. Neither static nor rigid, it seeks to provide a flexible structure for the acquisition process. The most important documents shaping current acquisition policy are DODD 5000.1 and its implementing instructions, DODI 5000.2 and DODI 5000.3. DODD 5000.1 takes a common sense approach, emphasizing tailoring, flexibility, and concurrency in order to provide efficient and effective system acquisition policy. Although DODD 5000.1 strictly applies only to major acquisitions, which are defined as those systems for which the Secretary of Defense (SECDEF) chooses to act as the program decision authority (PDA), it also requires that the management principles and objectives in that directive shall be applied to the acquisition of those defense systems not designated as major.

SECNAVINST 5000.1 invokes DODD 5000.1 and DODI 5000.2 not only for major programs but also, where specified, for nonmajor programs as well. SECNAVINST 5000.1 also specifies that programs of all other categories are to be guided by its principles. Such application, however, should be tailored to each acquisition program consistent with its nature and

cost. Figure 1-1 indicates the relationship of the documents that provide the foundation for the acquisition process.

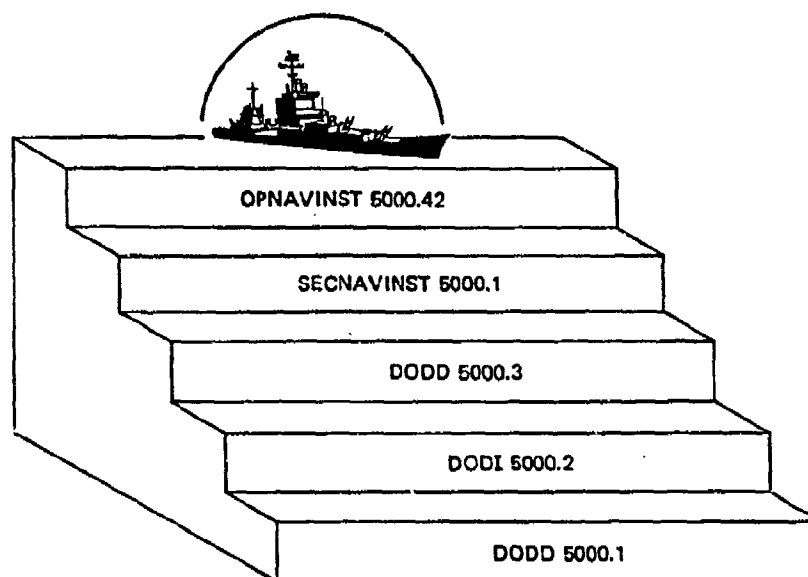


FIGURE 1-1. Relationship of Acquisition Documents.

Generally, DON acquisition policy calls for a program initiation decision to be made by the proper program decision authority and approval for program start to be integrated with the PPBS. At each subsequent major milestone, the PM is required to prepare the required milestone review documentation (MRD), and to have it reviewed by the chain of command and submitted to the PDA for final approval. The PDA documents his approval and gives instructions for program direction in a decision memorandum that marks the milestone.

Acquisition Categories (ACATs)

DON programs are classified by ACATs which determine the level of review, the PDA, and applicable procedures. Programs are assigned an ACAT when first authorized based to its estimated cost, criticality and political sensitivity. A program may be redesignated any time thereafter, consistent with the policy of controlled decentralization. Documentation supporting the program initiation and milestone decisions include appropriate ACAT recommendations.

ACAT I. The SECDEF designates those systems that are to be managed as major systems. Normally, this is done when the new start is authorized in the Program Decision Memorandum (PDM). The decision to designate any system as major may be based upon: (1) development risk, urgency of need, or other items of interest to the SECDEF; (2) joint acquisi-

tion of a system by the DOD and representatives of another nation, or by two or more DOD Components; (3) the estimated funding requirement (ACAT I thresholds are \$200 million (Fiscal Year (FY) 80 dollars) in RDT&E funds or \$1 billion (FY80 dollars) in procurement (production) funds, or both) and (4) significant congressional interest.

ACAT IIS. A program is a candidate for ACAT IIS designation by SECNAV, if (a) the total costs are expected to exceed \$100M for RDT&E, and/or \$500M for procurement (FY80 dollars); or (b) if it is of special SECNAV interest, such as a joint Service or multinational program; because of congressional interest; a history of technical, cost and schedule problems; an extraordinary acquisition strategy and/or risks; criticality of mission need; or unusual manpower and/or system needs or demands.

ACAT IIC. Programs for which the CNO is the PDA are designated ACAT IIC. Nominal thresholds for ACAT IIC programs are \$100M RDT&E and \$500M procurement (FY80 dollars), however programs will be considered for this designation on an individual basis, based on many factors. ACAT IIC designations are made by the Director, Office of Naval Program Planning (OP-090), based on Director, Office of Research, Development, Test and Evaluation (OP-098) recommendation.

ACAT III. Programs for which Deputy Chiefs of Naval Operations (DCNOs) or Directors of Major Staff Offices (DMSOs) are PDAs are designated ACAT III. There is no dollar threshold for ACAT III; programs are assigned this category if they affect military characteristics of ships or aircraft, directly affect the Navy's combat capability, or could be expected to interact with the enemy. Examples are radars, sonars, radios, navigation systems, electronic warfare systems, aircraft operational flight programs, or ordnance. ACAT III applies to hardware and software, new systems and modifications. OP-098 designates programs which are ACAT III, making case-by-case decisions based on all pertinent factors.

ACAT IV. All acquisition programs not otherwise designated are ACAT IV, with CNM (or his designee) as the designated PDA. Within ACAT IV, a new experimental category, ACAT IVT, has been established by OP-098, in an attempt to achieve greater decentralization of decision making. Other ACAT IV programs are designated ACAT IVM. The distinguishing feature on ACAT IVT programs (which would otherwise be ACAT III) is that they do not meet the new criteria for ACAT III (described above), but they do require operational test and evaluation (OT&E) (a Commander, Operational Test and Evaluation Force (COMOPTEVFOR) responsibility). Examples are a swimmer distress signal or the software program for a flight simulator. In ACAT IVT programs, should a disagreement arise between COMOPTEVFOR and the SYSCOM commander, the issue will be referred to CNM. ACAT IVT and IVM designations are made by OP-098.

The PM should be aware that a program may be raised or downgraded in significance to the DON and the DOD so that its level of approval and

ACAT may shift. A consideration in the assignment of an ACAT will be the number of programs already receiving SECDEF or SECNAV review. The number of programs subject to such high levels of review will be restricted.

Figure 1-2, on the next page, presents the foregoing and other information on the Navy ACATs in tabular form.

NOTE: The CNM has delegated responsibility for ACAT IV programs to the SYSCOM Commanders.

DOD Acquisition Policy

The principal thrusts guiding DOD acquisition policy include:

1. The requirement to express needs in mission terms and not equipment terms.
2. The requirement for agency head approval at key decision points (milestones).
3. The requirement that all goods and services be acquired on a competitive basis to the maximum extent possible in order to maximize innovation and minimize costs.
4. Consideration of life-cycle cost (LCC) such that affordability is put on an equal basis with system performance, schedule, and logistic supportability.
5. Establishment of clear lines of authority, responsibility, and accountability for the management of programs.

NOTE: At the direction of Congress, DOD is establishing the office of the Director of Operational Test and Evaluation. That office will be responsible for reviewing, for all ACAT I programs, the Test and Evaluation Master Plan (TEMP) and the operational test and evaluation results prior to each milestone decision.

DON Acquisition Policy

DON acquisition policy is based upon the principles applied in past successful projects and on experience gained in past unsuccessful projects. Emphasis is on defining the problem to be solved in terms of mission need, and tailoring the extent and rigor of the investigation of alternative solutions to the stated problem according to the specific need. In contrast with previous practice, the proposers of alternative concepts have much greater latitude in the approach they take in solving the problem posed in the program initiation document.

The DON also fully subscribes to the recent acquisition management initiatives of DOD to curb cost-growth trends. These initiatives are designed to enhance program stability, delegate authority for weapon

| Acquisition Category | Milestone | Review Document | Executive Review (1) | Decision Authority | Decision Document |
|----------------------|--------------------|-----------------|-------------------------------|--------------------|------------------------------|
| ACAT I | Program Initiation | JMSNS | OP-095 (2) | SECDEF | POM/PDM |
| | I | SCP & TEMP | DSARC DNSARC CEB ARB | | SDDM |
| | II & III (3) | DCP & TEMP (4) | | | |
| ACAT IIS | Program Initiation | OR | OP-095 (2) | SECNAV | POM |
| | I, II & III | NDCP & TEMP | DNSARC CEB ARB | | SNDM |
| ACAT IIC | Program Initiation | OR | OP-095 (2) | CNO | POM |
| | I, II & III | NDCP & TEMP | ARC/SCIB ARB | | CNO Decision Document |
| ACAT III | Program Initiation | OR | OP-095 (2) | Program Sponsor | POM |
| | I, II & III (5) | TEMP | SPR ARB | | SPR Decision Document |
| ACAT IV | Program Initiation | OR | OP-095 (2) | SYSCOM COR | POM |
| | I, II & III (5) | TEMP | ARB | | SYSCOM COR Decision Document |

NOTES

- (1) - The SCP/DCP/NDCP/TEMP review and approval process precedes the actual milestone review, decision and approval process.
 - (2) - OP-06 for strategic nuclear systems.
 - (3) - Milestone III decision authority is normally delegated to the SECNAV unless thresholds, established at Milestone II, are breached.
 - (4) - An IPS may be required when the DAE determines that the DCP lacks sufficient information on which to base a milestone decision.
 - (5) - Milestone I is normally eliminated.
- All TEMPs must also be approved by COMOPTEVFOR.
- See list of Abbreviations on facing page.

| | |
|-------------|---|
| ACAT | Acquisition Category |
| ARB | Acquisition Review Board |
| ARC | Acquisition Review Committee |
| CEB | Chief of Naval Operations Executive Board |
| CNO | Chief of Naval Operations |
| COMOPTEVFOR | Commander, Operational Test and Evaluation Force |
| DCP | Decision Coordinating Paper |
| DNSARC | Department of the Navy Systems Acquisition Review Council |
| DSARC | Defense Systems Acquisition Review Council |
| IPS | Integrated Program Summary |
| JMSNS | Justification for Major System New Start |
| NDCP | Navy Decision Coordinating Paper |
| OR | Operational Requirement |
| PDM | Program Decision Memorandum |
| POM | Program Objectives Memorandum |
| SCIP | Ship Characteristics and Improvement Board |
| SCP | System Concept Paper |
| SDDM | Secretary of Defense Decision Memorandum |
| SECDEF | Secretary of Defense |
| SECNAV | Secretary of the Navy |
| SNDM | Secretary of the Navy Decision Memorandum |
| SPR | Sponsor's Program Review |
| SYSCOM CDR | System Command Commander |
| TEMP | Test and Evaluation Master Plan |

FIGURE 1-2. Acquisition Categories (ACATs).

systems program management, achieve more economical rates of production, and attain realistic costing and budgeting for weapon systems. Other significant changes from past policy are the increased emphasis on affordability, competition, system readiness and sustainability, pre-planned product improvement (P³I), and incorporation of initial program approval into the PPBS.

Mission Need Versus Technology as System Drivers

In the 1970s, system acquisition programs were usually focused on specific technical approaches at the time of their initiation. These programs might be carried well into the advanced development stages before alternatives for fulfilling the mission need had been considered. In addition, the total development, production, and support cost of a particular technical approach (LCC) often was not considered in the initial stages of the acquisition process, and by the time the prohibitive cost of deployment was revealed, enormous amounts of time and money had been expended. Today, a program is initiated after competent authority, the PDA, approves a specific, formally stated mission need, based on MAA, submitted within the first Program Objectives Memorandum (POM) in which program funds are requested.

Flexibility

The current system provides for and encourages flexibility in the acquisition process. Each program should be evaluated separately, and the acquisition strategy should be tailored to best reconcile technological risk, development time, and cost. There are several points at which the PM may shorten phases or bypass them altogether. The PDA may approve elimination of the Concept Exploration and Demonstration and Validation Phases, authorize development of a non-competitive (single-concept) system, and increase the degree of concurrency if these steps are justified by urgency of need or by the demonstrated maturity of the selected concept. In all cases, it is the PM who must take the initiative of shaping the program to give it the flexibility that the acquisition process permits and encourages.

Costs and Schedule

Regardless of the magnitude of the program, DON policy requires a continuing effort to reduce and control the costs of new system acquisitions and to shorten the time between program initiation and fielding of the needed systems. While it is recognized that the PM's concern is often fixed on development costs, increasingly, concern at higher levels and in Congress is on life-cycle costs. As a result, it is often possible to justify increased development cost if savings can be made later in reduced production and/or operational expenses.

Alternatives to a New Start. Before a new start is initiated, alternatives that are evolutionary and low risk must be examined. The need may be filled by changes in doctrine or tactics, or by an adjustment in the level or mix of forces. Existing equipment may be altered

or upgraded to fill the need, or foreign equipment may do the job. A new development is in fact the least attractive alternative available because of its intrinsic cost-schedule-performance-supportability uncertainties. However, the CNO has stated that we cannot be overly reliant on risk-avoidance approaches when the risk of technical surprise from a rapidly modernizing threat is growing.

Relationship of Development Cost in System Life-Cycle Cost (LCC).

From a program's outset, LCC - total cost to the government of acquisition and ownership of a system over its full life, including cost of development, procurement, operation, support, and where applicable, disposal - must be considered on an equal footing with performance, time and logistic supportability constraints. Decisions made very early in a program determine the costs throughout the life of the system. This fact is graphically illustrated in Figure 1-3. Note that decisions made during the Concept Exploration Phase (especially the decisions as to which concept is selected and what the performance thresholds are) fix approximately 70% of the LCC. Roughly 85% of the LCC are frozen before the Full-Scale Development Phase begins, when only a small percentage of the total system cost has been expended. A little more money spent in the early stages of the program can save a great deal of money over the life of the system.

Because of the effect that the chosen concept has on the LCC, a broad solicitation of concepts from the civilian sector and Navy in-house activities is required. This competitive approach provides a wide range of concepts from which to select the most feasible means of fulfilling the mission need and, at the same time, provides alternative performance levels, schedules, and cost estimates with which to make performance/cost/time trade-offs.

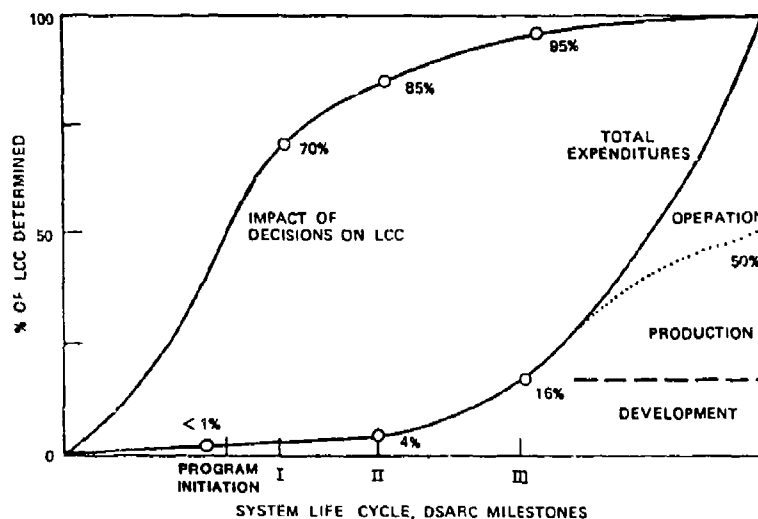


FIGURE 1-3. Typical Weapon System Life-Cycle Cost (LCC).

Realistic Costing and Budgeting. Large growth in costs during a system's development and operation seriously undermines both the Congress' and public's faith in the Navy and DOD. Such cost growth significantly impairs the Navy's ability to budget for the necessary quantities and types of weapon systems.

The PM must ensure that only realistic cost and budget information is provided and that such information is accurate and complete. Cost estimates must include the full anticipated development, production, and operational costs associated with the program, even though this task is especially difficult at program initiation. The estimates will include budgeting and early funding for testing (including adequate numbers of test items, special test equipment, and facilities), budgeting for most-likely costs (including inflation), budgeting for technical and scheduling risks, capitalization of production and specialized operational facilities, and independent cost analysis.

Reliability, Readiness and Logistic Supportability

As indicated in Figure 1-3, operation and support costs of a system often account for 50 to 60% of the total LCC. Significant savings can be achieved through investments early in the program that will increase system reliability and simplify maintenance. Reliability and logistic supportability are design attributes, and improving them will markedly increase system readiness. DODD 5000.1 and DODD 5000.39 require that acquisition programs shall have an integrated logistic support (ILS) program that begins at program initiation and that readiness objectives and related design requirements/activities be established early in the acquisition process, specifically in the acquisition strategy, and that they receive comparable emphasis with cost, schedule and performance objectives.

Competition

The DON acquisition policy recognizes that competition encourages innovation and efficiency, providing quality products at the lowest possible price; and the requirement to seek competition is a continuing legal obligation, not just a platitude periodically dusted off for seminars and conferences. How much competition, how long such competition should be maintained in the development process, and at what cost are issues that must be determined independently for each program. The PM must determine how and to what level (system, subsystem, component) to develop and maintain beneficial competition. If it is desirable to maintain competition through the production stage, he must ensure that adequate documentation is produced during the development stage. Competition is one of the key elements to be addressed in the acquisition strategy.

Competition in Contracting Act of 1984 (CICA)

Implementation of the CICA is a major endeavor including substantial revision of the Federal Acquisition Regulations (FAR) and the DOD

Federal Acquisition Regulations Supplement (DFARS). The major thrust of CICA is establishment of full and open competition as the standard in government contracting. In so doing, the statutory distinction between formal advertising and negotiation is removed eliminating the need for Determinations and Findings (D&Fs) to support negotiated procurements. The term "sealed bid" replaces the term "formally advertised" but the related solicitation and bid procedures remain the same. Sealed bids will be used when appropriate conditions exist.

Competition requirements are being consolidated and published in a new Part 6 of the FAR. There will be 7 specific exceptions to the use of full and open competition. When use of other than full and open competition is contemplated, a detailed justification must be submitted for approval by the appropriate authority depending upon the estimated dollar amount of the procurement as follows:

- \$100,000 to \$1M - procuring activity Competition Advocate
- \$1M to \$10M - head of the contracting activity or flag/SES delegate
- Over \$10M - Navy Senior Procurement Executive (NSPE)

The NSPE is the Assistant Secretary of the Navy, Shipbuilding and Logistics [ASN(S&L)]. For those actions requiring NSPE approval, an approved Acquisition Plan (AP), as required by FAR Part 7, must be submitted along with the justification.

CICA and the related regulation changes will apply to all solicitations issued on or after 1 April 1985.

Key Decision Points

An important feature of the present acquisition policy is the reservation of final review and key decision-making to SECDEF for major programs and to appropriate decision authorities for less-than-major programs. This feature is intended to ensure that the proper level of review is made prior to the commitment of major resources and that efforts to meet the stated mission need are being pursued within the bounds of current acquisition policy. Review is also conducted at various levels between the PM and SECDEF or other designated PDA, with the highest review group - the Defense Systems Acquisition Review Council (DSARC) - giving advisory support to SECDEF.

Streamlined Procurement Approach

A single solicitation calling for several follow-on proposals may serve the procurement needs of the entire program. Procurement is also facilitated by the requirement to minimize detail in the documentation. Initially, the required documentation describes the mission need and constraints only (e.g., ability to interface with certain other systems) and avoids specific solutions and detailed specifications. The documentation is then refined as the program progresses through the acquisition

phases. At the end of the Full-Scale Development Phase, the documentation is complete and is sufficiently detailed to support the full-scale production effort, deployment and operation.

Preplanned Product Improvement (P³I)

The time from inception of a system to initial operational capability (IOC) is often inordinately long, because of the approval process, single-year funding, the increasing complexity of modern systems, and a desire on the part of system designers and sponsors to develop an end product that will do everything. However, a system that will fulfill 90% or more of the mission goals can often be designed in far less than 90% of the time necessary to achieve all of the goals. A P³I plan facilitates the trade-off between time and performance and allows earlier Fleet introduction of needed capabilities and reduces program risk.

P³I is an acquisition concept that encourages orderly, time-phased introduction of incremental system capability. P³I can accommodate projected changes in threat or reduce the risk inherent in fielding a system that is dependent on unproven technology. The concept involves programming resources to accomplish orderly and cost-effective evolution of a system's capability, utility, and operational readiness. As well as minimizing the technical risk of fielding a system, P³I reduces the potential for delayed Fleet introduction that is posed by using new technology to meet a military threat.

When P³I is incorporated in the acquisition strategy, some potential initial capability of the system may be sacrificed to obtain a meaningful improvement in Fleet capability in a much shorter time than would otherwise be possible. Successive improvements in the system are made on a planned basis after the IOC date.

If P³I is to receive adequate consideration during the system acquisition process, PMs must ensure that:

1. System need documents include stepped requirement, performance, and readiness increases and list growth potential as a high-priority characteristic.
2. P³I is placed in the acquisition strategy and detailed in the program management document schedules and resources computations.
3. Growth requirements are translated into design criteria that are substantiated through development testing.
4. Incentives are provided in the development contract for the achievement of growth provisions.
5. P³I modifications are scheduled, programmed, budgeted, and planned for Fleet introduction with the same attention to detail as the basic system. The resources to accomplish P³I should be identified by the PM for inclusion in the PPBS cycle and placed in the POM, The Five-Year Defense Program (FYDP), and the Extended Planning Annex (EPA). Once P³I becomes a part of the acquisition strategy, failure to fund it

will be considered a major change in program direction.

Besides shortening the inception-to-IOC time, P³I may tend to make PMs and sponsors more receptive to criticism of system shortcomings and thus promote a more open relationship with Congress. By planning the growth from the initial design stages, P³I permits development of a system that is receptive to modification in response to downstream threat-definition changes and future technology development.

Product Improvement

The modification and improvement of systems which have been developed without P I is often necessary. This is often the least expensive and most rapid means for meeting new Fleet needs. Deficiencies may be uncovered during fleet use that not even the best engineering could have predicted or evaluation programs discovered. A strong follow-on engineering effort may be entered into with the objective of eliminating lingering deficiencies, enhancing producibility, and realizing the full potential of the system. Current congressional sentiment is not to fund simultaneous production and product improvement effort.

THE ACQUISITION PROCESS

The DON's system acquisition process normally consists of four phases which are separated by decision milestones as shown in Figure 1-4. The phases are tailored to fit each program's specific requirements to minimize acquisition time and cost, consistent with the need and the degree of technical risk. The decision milestones are adjusted to match the selected acquisition strategy.

The acquisition process, though conceptually simple, is detailed in its requirements. As indicated in Figure 1-5, ship design/development milestones are somewhat different than the milestone characteristic of a typical weapon system acquisition. What follows provides an overview of the process, concentrating on the logical interrelationship of the milestones and phases and deferring to Section 3 a more extensive description of each milestone and phase activities.

Program Origins, Mission Area Analysis (MAA)

The starting point of the acquisition process cannot be pinpointed. It emerges gradually from the naval operational experience, advances in the technology base, and intelligence assessment of the threat - all integrated through ongoing MAA. During this process, a need is perceived in a particular mission area. The need may arise from a changed threat, projected obsolescence of existing systems, technological opportunity, or a cost-reduction opportunity. The DON will evaluate the need in light of other needs, existing capabilities, priorities, and resources, and if warranted, prepare a requirements document describing the mission need.

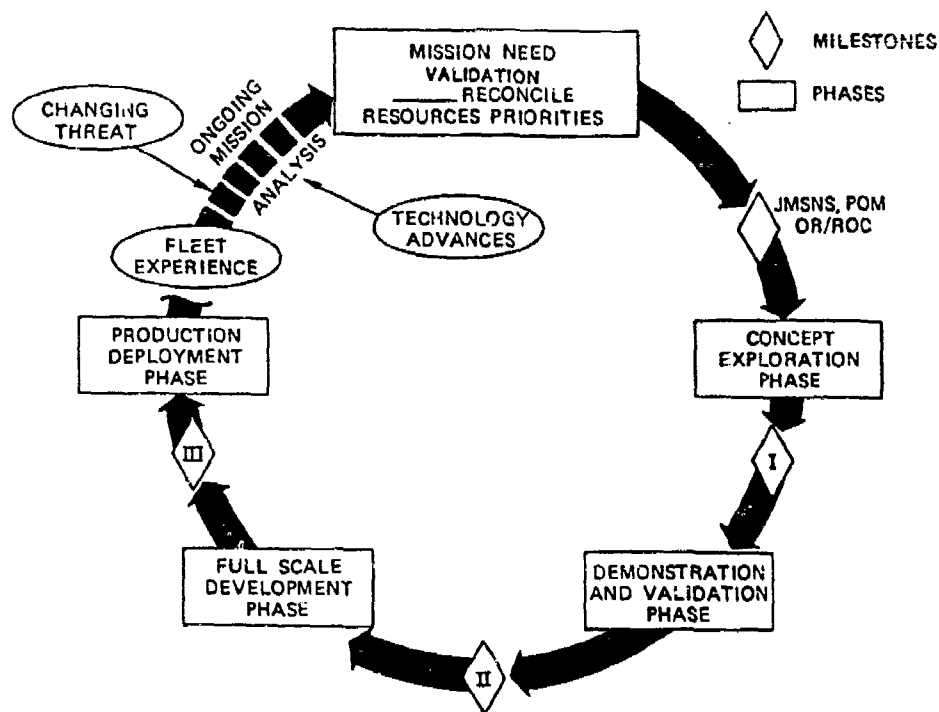


FIGURE 1-4. Acquisition Phases and Milestones.

| | Phase Event | |
|-------------------------|---|--|
| | Ship acquisition (design, development for operational use) normally ACAT I or IIS | Ship development (design & construction for research, test or evaluation) normally ACAT IIS or lower |
| Authorized at milestone | | |
| Program Initiation | Conceptual design and trade-offs | Conceptual design and trade-offs |
| I | Start preliminary design; preliminary contract design | Start preliminary design |
| II | Decision for lead ship design and construction | Contract design and decision to build |
| III | Design for follow-on ships | ... |

FIGURE 1-5. Ship Design/Development Milestones.

Program Initiation

Program initiation is accomplished as part of the PPBS process based upon the mission need document, a Justification for Major system New Start (JMSNS) or an Operational Requirement (OR). This document is normally submitted during the POM preparation, review and approval process for the budget year in which funds are requested. The PDA provides appropriate program guidance after such review. This action provides official sanction for a new program start and authorizes, when funds are available, the initiation of the initial acquisition phase. Depending upon the circumstances, approval may be given to omit one or more of the following phases.

Concept Exploration Phase

During the Concept Exploration Phase, the PM will solicit and evaluate alternative concepts that will meet or exceed the thresholds of the approved need document. This will be accomplished in cooperation with industry, in-house Navy Research and Development (R&D) laboratories/centers, universities, and federal contract research centers (FCRCs), all of which are equally acceptable concept sources. Candidate concepts will be presented along with estimates of their LCC, development schedule, and performance. Candidate concepts in the form of technical feasibility models may be subjected to development test and evaluation (DT&E) and initial operational test and evaluation (IOT&E). The PM, in part through the use of independent cost and technological analysis, will evaluate the alternative concepts and recommend one or more for continuation into the Demonstration and Validation Phase.

The results of the Concept Exploration Phase are documented, and the results and issues are discussed in the milestone review documentation (MRD) prepared by the PM.

Milestone I

The first major milestone decision is concept selection and approval to enter the Demonstration and Validation (D&V) Phase. This decision is a validation of the requirement, based upon preliminary evaluation of alternative concepts, costs, schedule, readiness objectives and affordability. It provides authority to develop the conceptual system(s) sufficiently to support the next milestone decision. The Milestone I decision establishes thresholds and objectives to be met and reviewed at the next milestone, the acquisition strategy for the program (including the nature and timing of the next decision point), and a dollar threshold that cannot be exceeded to carry the program through the next milestone. NOTE: For ACAT III and IV programs, Milestone I may be eliminated on approval of the acquisition executive.

Demonstration and Validation (D&V) Phase

The key to a successful D&V Phase is a well thought-out design effort. Industry, R&D center and/or federal contract research center

(FCRC) advanced development models (ADM)s/functional breadboards are fabricated to demonstrate and validate the critical technical and operational features of the selected concepts. This involves demonstration of the system or critical subsystems to verify performance, ascertain the potential suitability of a concept to fill the mission need, and establish a credible baseline LCC estimate. The results of the D&V Phase (which may include OT&E) will be documented in MRD prepared by the PM.

Milestone II

The D&V Phase MRD is briefed and reviewed as appropriate. The timing of the Milestone II decision is flexible and depends upon the tailored acquisition strategy approved by the PDA at Milestone I.

Full-Scale Development (FSD) Phase

The goal of the FSD Phase is to produce a fully tested, documented, and production-engineered design of the concept selected in the D&V Phase. This design must be cost-effective, operationally suitable, and producible. It is developed through an iterative process of design-test-redesign. The final product is a baseline configuration design and documentation package. The development effort normally proceeds through three distinct subphases, each of which has an integral testing and evaluation element.

During the engineering subphase, the engineering rendition of the selected technical approaches will be evolved in the form of engineering development models (EDMs)/brassboards, and will be tested and evaluated prior to a critical design review (CDR). A considerable saving may be afforded by using simulations and laboratory testing before going to the field for expensive testing and evaluation.

In the prototype subphase, preproduction prototype models (PPMs) of the engineered designs will be constructed, tested, evaluated, and corrected as necessary to evolve a cost-effective physical and functional equivalent of the system to be produced in the subsequent pilot-production subphase. Models fabricated during the last part of the prototype subphase will be used to conduct a formal technical evaluation (TECHEVAL) in order to determine and certify readiness for formal operational evaluation (OPEVAL).

In the pilot-production/transition to production subphase, the data package that was evolved and evaluated in the preceding prototype subphase will be exercised in the production environment. The system will be fabricated with production tools and test equipment, using production processes, procedures, and inspection techniques. The first units derived from this effort will be evaluated for any degradation resulting from the production process. The remaining units will provide the test articles required for OPEVAL, leading to final determination of operational effectiveness and operational suitability that is required for approval for full production (AFP) and support of the major production decision, Milestone III. Any remaining units will be used along with

those from the Production and Deployment Phase to provide for the IOC. As in the previous phases, the results of the FSD Phase, and discussion of these results and issues are documented by the PM in the MRD.

Milestone III

The MRD is reviewed as appropriate and the PDA's decisions are documented in a new decision memorandum. When signed by the PDA, the decision memorandum authorizes the PM to proceed with the Production and Deployment Phase. In certain cases the PDA may delegate the Milestone III decision to the lowest level in the organization at which a comprehensive view of the program rests. Normally the Milestone III decision for a DOD Major program is delegated, by the SECDEF, to the SECNAV unless the thresholds established at Milestone II are breached.

Production and Deployment Phase

During this phase, the development activity will proceed with the planned procurement program and introduce the system into the Fleet. The DON will normally proceed with the first volume production by contracting with the development contractor, depending on the approved acquisition strategy. For high-volume production systems where competitive procurement can be justified, early actions should have been taken in the previous phases to qualify an alternative or second source. Follow-on operational test and evaluation (FOT&E) and user data are necessary elements for verifying correction of any deficiencies noted in OPEVAL and for continued product improvement and tactics development.

Low-volume, highly sophisticated systems that require high-value facilities, tools, test equipment, and an inordinately long lead time may not be amendable to competitive procurement. The decision on whether to have competitive procurement must be determined on an individual basis for each program. It should be made only after a detailed cost-benefit analysis and determination of the level of mobilization requirements. Even if the analysis indicates that competitive system acquisition is not supportable it may be desirable to acquire subsystems or components on a competitive basis, especially if the same subsystems or components are used in other systems. The necessary preparations will have had to be made prior to or at the beginning of the Full-Scale Development Phase to readily allow component breakout for competitive procurement or as government-furnished equipment (GFE) to maximize cost savings and to ensure system compatibility.

Figure 1-6 shows the interfaces of events, documents, and organizations in the acquisition process. Figure 1-7 presents a summary overview of the acquisition process. There will be some variation from the pattern indicated here as each PM, with the consent of the appropriate PDA, tailors his acquisition strategy to suit the need of his program.

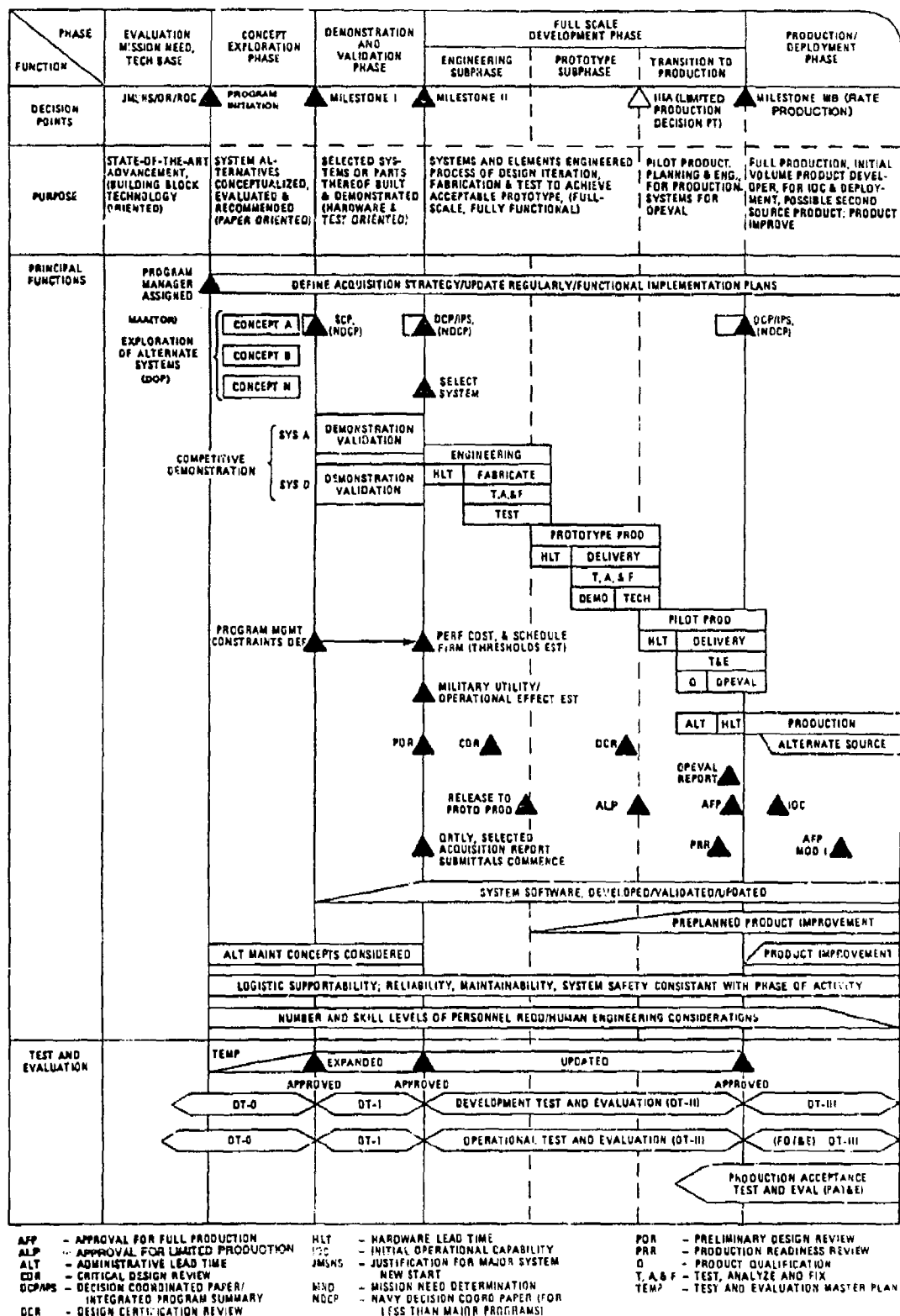


FIGURE 1-7. Summary Overview of the Acquisition Process.

ACQUISITION PRINCIPLES

In addition to the critical topics covered in Section 4, a PM should be aware of the 24 acquisition principles enumerated below. These principles are based, in part, on the DOD Acquisition Improvement Program - the "Carlucci Initiatives." The principles emphasize sound business and management practices that require action by the PM throughout each phase of the acquisition.

1. Responsibility, authority, and accountability for programs shall be placed at the lowest level of an organization at which effective management of the program can be accomplished.

2. PMs shall have responsibility, authority, resources, and a properly documented statement of requirements and funding to enable accomplishment of the assigned task.

3. PMs shall have authority to exercise flexibility in tailoring the acquisition strategy.

4. PMs shall evaluate alternatives which rely on evolutionary low-risk technology during acquisition strategy formulation, along with those that rely on advanced high-risk technology.

5. PMs shall consider P I in developing the basic program plan.

6. Pursuit of economical rates of production, tempered by appropriate constraints, is a fundamental goal.

7. A vigorous policy of standardization shall be considered in all acquisition programs and pursued when beneficial.

8. All DON personnel shall maintain a business-like approach with industry, fundamental to successful motivation and teamwork.

9. Industry comment on draft requests for proposal shall be solicited when it appears to be beneficial to efficient and effective execution of the program.

10. Industry shall not be misled regarding the status of a program or the availability of funding.

11. Acquisition strategies shall recognize the importance of obtaining and maintaining a viable industrial base.

12. Data shall only be procured when there is a specific need and shall be sufficient to support planned life-cycle maintenance.

13. Effective estimating resources shall be provided and utilized in all program phases.

14. Program budget and schedule profiles shall reflect realistic program estimates.

15. The acquisition strategy and program alternatives shall be formulated with due regard to the minimization of total life-cycle costs.

16. Acquisition managers shall actively participate in cost savings programs. Value engineering shall be emphasized.

17. Multi-year procurement shall be considered in all applicable situations.

18. Contract negotiations shall be based on an independent Navy cost analysis whenever it is possible to develop such an analysis.

19. Competition shall be vigorously pursued when there is a potential for beneficial results.

20. Contract changes shall be minimized and when issued, they shall be adjudicated as expeditiously as possible.

21. The acquisition process shall be expedited to the maximum extent possible. The use of class determinations and findings shall be maximized and consideration shall be given to combining the Source Selection Authority and the Source Selection Council Chairman where appropriate.

22. Past performance or experience shall be recognized during source selection and cost realism shall normally be used as a selection criteria in cost reimbursable contracts.

23. Reliability, maintainability and producibility shall be emphasized commencing with initial design.

24. Logistic support standards shall not be compromised.

Section 2

PROGRAM MANAGEMENT

Section 2

PROGRAM MANAGEMENT

ROLE OF THE PROGRAM MANAGER (PM)

PMs, within their chartered responsibility, shall exercise technical and business/financial management for the accomplishment of the program objectives within approved constraints and thresholds. In order to do this, the PM will need to develop a broad array of managerial skills. Many of these skills will have their locus in the program management organization and support activities, but certain ones must reside in the PM himself.

NOTE: To reduce the number of PMs reporting to a SYSCOM Commander, the SYSCOM may, in accordance with SECNAVINST 5000.1, and where necessary or advisable, designate a Program Director (PD) over several PMs for projects in a particular warfare or mission area. A PD is a line authority and no PM shall be responsible to more than two levels of line authority below CNM. The designation of a PD does not alter the command or major-command-equivalent status of the subordinate PM.

The PM will be the primary advocate for the program. At the outset, the prospective PM must be thoroughly convinced of the need which the program addresses before he takes on the PM responsibility. He must completely understand the military need for the system and must become intimately familiar with the system as it evolves. Since a series of minor decisions can have a major impact on the program, the PM must understand and appreciate the implications of each trade-off decision.

The PM must understand that he and he alone is responsible and accountable for the success or failure of the program. He will get much free advice - some of it of little value - from all levels in the management hierarchy. Advice can be helpful, but the buck stops with the PM except when he is directed, in writing, by higher authority. While the PM must be responsive to higher authority, he cannot be passive with regards to the needs of his program. Since he is the primary advocate for the program, he must actively seek the necessary support from higher authority.

The other side of the issue bears noting as well. Seeking out and listening to "good news" and advice from those who will corroborate the PM's viewpoint can be dangerous. He must establish a system for gathering, as early as possible, all program-relevant information so that he can act on the information while options are still open.

The PM must learn, as soon as possible, the entire environment - up, down, inside and outside of the Government - within which the program exists (Figure 2-1). In this connection, it would be most helpful to have on the staff one or more people who are intimately familiar with the organizational and political system and who can get things done. The PM must know who is active, who is passive, where funds come from and how they get to the program, and who can be relied

on for good, sound, technical advice. A champion within the upper levels of the Office of the Chief of Naval Operations (OPNAV), Office of the SECDEF (OSD), and/or Congress can be invaluable. It is worth the PM's investment of time to keep such individuals informed and involved.

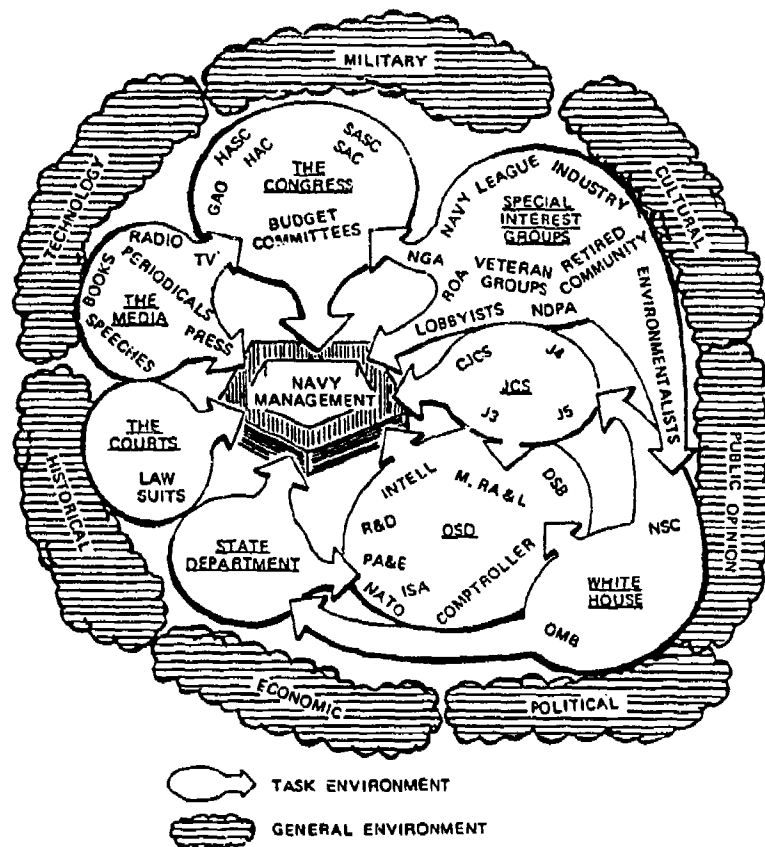


FIGURE 2-1. External Influences on Program Management Decisions.

Finally, the PM must manage effectively. In executing the program assignment, he will draw heavily on experts from many functional organizations and will establish lines of organizational control. There are three cardinal rules for the PM to follow:

1. Don't try to do everything yourself. Accomplish your purposes by working with and through your program organization. Develop a competent staff and use them.
2. Plan the work ... then work the plan
3. Organize your resources to fit the program. Ensure that everyone having anything to do with the program knows the organization and how it is intended to work. Insist that everyone work within the constraints of the organization unless you authorize a deviation.

PROGRAM MANAGER (PM) RELATIONSHIPS

The PM has less control over his relationship upward than those downward. Upward relationships will in large measure be determined by the military/governmental matrix within which the program must be pursued. Certain specific relationships will be described in the PM's charter. The prime obligation that the PM has to those above him is to provide them with a steady, reliable flow of timely information about the program.

If a serious problem develops within the program, it is better that the program sponsors in the SYSCOM, NAVMAT and OPNAV get the bad news from the PM rather than from someone else who does not have the PM's comprehensive view of the relationship of the problem to the entire program. This does not mean that the PM should be an alarmist. However, it may be appropriate, on occasion, to "raise a pink flag" in the form of informal liaison with his sponsor. Candor at an early stage will help to establish and later to maintain the PM's credibility with his sponsor if a minor problem develops into a major one. No major system acquisition program is without problems, and these should be solved by tackling them directly, in the open, as soon as they develop. It is not a sign of weakness to bring the necessary expert or back-up support to meetings of critical issues.

At the earliest stages of the project, the PM will have considerable flexibility in establishing the relationships within his organization and between himself and elements of that organization. These relationships are subject to change at any time during the program if the PM finds that this will help him more effectively accomplish program goals and so long as these changes are not inconsistent with the policies and procedures established by higher authority. At any given point, however, the relationships should be treated as fixed. Reorganization must not be used as a cosmetic to cover inadequacies in program accomplishments and planning. Reorganization may be harmful to the program because it disrupts personal commitments and communication links, and may dilute corporate memory in the areas changed.

The tone set by the PM in his relationship with his sponsors and those above him will be reflected in his relationships with the program management team. If a team spirit can be instilled in the program personnel, they will perform their work more effectively. It is important that the organizational diagram not be contrary to the existing assignments of organizational functions, but this does not require slavish adherence to form. Team members should be encouraged to assume more than the minimal responsibilities required by their job description, particularly in the area of identifying and giving visibility to potential problems. The PM's support of his team members promotes subordinate responsibility and team spirit. Although it is not a requirement and is seldom done, primarily because of time and other pressures, it would be well for the PM to take his entire management/support team aside to develop a mutual understanding of the organizational interfaces and how the management structure is to function as well as to establish interpersonal rapport.

The Program Coordinator/Development Coordinator

Organizational interfaces are extremely important. Within NAVMAT, these are stipulated and controlled through the PM's charter. The PM's contacts with the DON outside of NAVMAT, i.e., OPNAV, OSD, Office of Management and Budget (OMB), Congress, etc., are established primarily by working with and through the OPNAV program coordinator and development coordinator.

The program coordinator is the OPNAV official responsible to the program sponsor (the Deputy CNO (DCNO) or the Director, Major Staff Office (DMSO), for a force, platform, or support area). The development coordinator is an official on the staff of the OPNAV appropriation sponsor. For the RDT&E,N appropriation this is the Director, RDT&E (OP-098). The PM is the principal contact with the program coordinator and development coordinator for all matter relating to the program. The Navy Programming Manual describes these relationships further.

Both the program coordinator and the development coordinator are concerned with more than one program; therefore, it is up to the PM to make his relationships with them work. To do this, the PM must supply useful and correct information. He needs the wholehearted cooperation of the program coordinator and development coordinator, especially in defending the program's budget. Figure 2-2 illustrates the PM/program coordinator/development coordinator relationship.

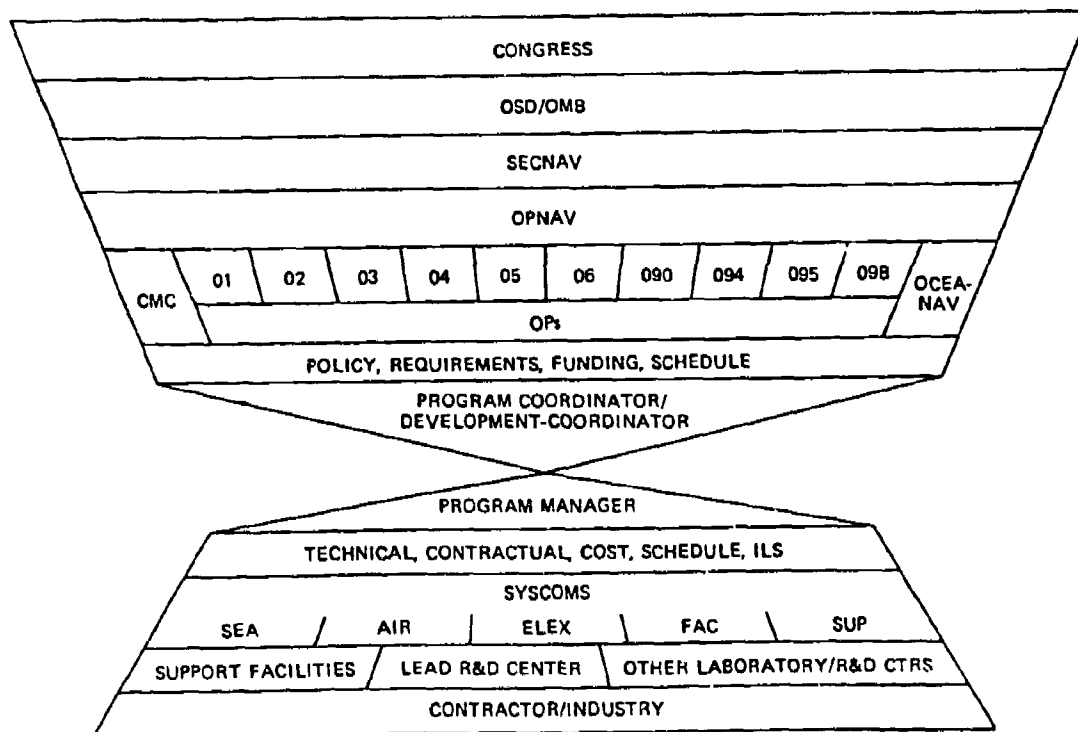


FIGURE 2-2. PM/Program Coordinator/Development Coordinator Interface

The PM assesses the progress of the project against the requirements levied, identifies any need for modification of the requirements, and obtains OPNAV approval of required changes. The program coordinator typically acts as the focal point for the PM for all contacts within OPNAV and participates with the PM in the preparation and presentation of proposed project actions to higher authority.

Collectively the PM, program coordinator, and development coordinator bring managerial objectivity to the program. The PM, being hardware-oriented, relates software, personnel, and facilities to the development and acquisition of the hardware elements of the system. The program coordinator and development coordinator maintain an overview of program activities from the point of view of OPNAV and the operating forces, determine whether or not the program is proceeding in accordance with the need documents, and facilitate the coordination of programming actions within OPNAV.

Ethics

A PM, if he does not know it already, will soon learn that if he desires, he and many of his staff and team members will be courted assiduously by a great variety of industrial concerns wanting to establish and/or maintain cordial contract relations in support of the program. The Navy and Marine Corps are justifiably proud of the accomplishments and special efforts of their military and civilian team. It has therefore been terribly disappointing to find that a few individuals have tarnished the Navy/Marine Corps reputation by defrauding the government, wasting government resources, or abusing positions of trust for personal gain. The Chief of Naval Operations (CNO) and the Secretary of the Navy (SECNAV) have made elimination of fraud, waste, and abuse their personal goal. Congress, in reaction to lapses in the ethics of government employees, has enacted legislation establishing higher standards of conduct within the Ethics in Government Act of 1978.

The PM must be rigidly ethical in all his dealings with contractors and must see that everyone in his organization follows his example. Although it is not likely that a PM or any other team member would compromise his integrity or allow the success of the program to be jeopardized for the price of a lunch, the PM and all others should realize that, like Caesar's wife, they must not only be above reproach but must also give the appearance of being so. Being discreet is not enough. Acceptance of such emoluments makes it increasingly more difficult to render objective decisions on contractor/government disputes and other differences of opinion with the contractor that might arise from time to time. Specifically, the PM and his staff should avoid any action which might result in, or create the appearance of:

1. Using a government position for private gain.
2. Giving preferential treatment to any person or organization.
3. Impeding government efficiency or economy.
4. Losing complete independence or impartiality.
5. Making a government decision outside official channels.
6. Adversely affecting the confidence of the public in the integrity of the Government.

Program Manager's (PM's) Charter

The new PM may report directly to the Chief of Naval Material (CNM) or to the Systems Command (SYSCOM) Commander whose mission most directly relates to the program. For ACAT I and IIS programs, a PM must report directly to the CNM or SYSCOM Commander, except a SYSCOM Commander may, if necessary or advisable, designate a Program Director over several PMs for a particular warfare/mission area. No PM shall report to more than 2 levels of authority below the CNM. The PM is charged with responsibility for acquiring and fielding, in accordance with the instructions from line authority, a cost-effective solution to the approved mission need that can be operated and supported within available resources - the resources projected in the milestone decision memorandum. The precise scope of his responsibility and authority will normally be delineated in his charter. In the real world, not all significant acquisition programs are managed by formally chartered managers. The effectiveness of the PM depends largely on the authority that he exercises through persuasiveness and by fostering teamwork.

The charter is a document promulgated by a Naval Material Command (NAVMAT) or SYSCOM directive, depending upon whether or not it is a CNM- or a SYSCOM-managed program. It defines the PM's mission, and responsibilities, and describes his relationships with other organizations and activities. It will also include assignment of a technical manager/systems engineer, a business/financial manager and a logistics manager, as well as the designation of a contracting officer who shall be responsible for all contractual matters relating to the program. Other functional support required by the PM such as assignment of a lead laboratory, when appropriate, will be identified in the charter. Figure 2-3 provides the outline of a PM charter. A more complete discussion of the charter is set out in the governing instruction, NAVMATINST 5000.21.

| TITLE | |
|-------|---|
| 1. | <u>System Description.</u> An unclassified description of the deliverable end items. |
| 2. | <u>Scope of the Program.</u> |
| 3. | <u>Authorities.</u> Include special authorities which are unusual or peculiar to the program. |
| 4. | <u>Limitation of Authority.</u> |
| 5. | <u>Responsibilities.</u> Include special responsibilities which are unusual or peculiar to the program. |
| 6. | <u>Relationship to Chartering Authority.</u> |
| 7. | <u>Special Operating Relationships.</u> |
| | a. Relationships with activities above the NAVMAT level or outside of the Navy Department. |
| | b. Relationships with activities at the NAVMAT level. |
| | c. Relationships with activities at the SYSCOM level. |
| | d. Relationships with field level activities. |
| 8. | <u>Supporting (Participating) Organizations.</u> |
| 9. | <u>Initial Staffing and Organization.</u> |
| 10. | <u>Program Transition or Disestablishment.</u> |

FIGURE 2-3. Outline of the Program Manager's Charter.

The charter is a mutually agreed-to contract between the PM and his superiors. It is prepared by NAVMAT with the assistance of the PM or SYSCOM personnel, or both, and approved by CNM. Due to its contractual nature, the PM should ensure that the charter provides an adequate framework within which he can function effectively. All PM charters are submitted through MAT-OBP for coordination and are approved by the CNM before promulgation. Once the charter is approved, any program decisions made by line officials above the PM in the chain of command are to be documented in writing. At that point, the line official becomes accountable for the decision and its consequences.

PROGRAM MANAGER'S (PM'S) EFFORT

The PM must see that there is sufficient, factual information generated in each phase of the acquisition process to permit intelligent recommendations to be made to the program decision authority (PDA) for the conduct of the next phase. He must develop (independently, but with appropriate contractor inputs) such documentation as the Test and Evaluation Master Plan (TEMP), the Integrated Logistic Support Plan (ILSP), the Naval Training Plan (NTP), plans for manpower, personnel and training support (MP&TS), independent life-cycle cost (LCC) analysis, risk analysis, survivability/vulnerability analysis, system safety program plan, mission profile definition, and system software definition. (These subjects are discussed in more detail in Section 4, Critical Topics) The PM must also oversee the conduct of the RDT&E and production program and conduct trade-off analyses of the competitive systems. He may find it necessary to initiate parallel or backup in-house Navy technology efforts to determine alternative means for dealing with identified high-risk areas and to develop system software. A large part of the PM's time and effort will be spent in active liaison with the PDA and the chain-of-command leading to the PDA, informing them of the program's progress and possible problems, and justifying the program funding and objectives.

PROGRAM MANAGER (PM) SUPPORT

While responsibility for the success or failure of a program rests on the PM's shoulders, he is helpless alone and requires a strong support team for the successful completion of his program. Thus the single most important management element for the PM is building and motivating the program team. The PM needs to work through others.

The required support can come from many sources: the immediate PMO, Headquarters support, Navy in-house R&D centers/laboratories, T&E facilities and field support stations, other DOD facilities, Government plant representatives, industrial and consulting organizations (contractors), Federal contract research centers (FCRCs), universities, and other not-for-profit institutions.

Matrix Management

Except for a very few major programs, most Navy-managed programs

will be chartered to a SYSCOM. The SYSCOMs, for the most part, use matrix management systems in which PMO staffs of experienced personnel provide intensive management. The PMOs, in turn, utilize line functional organizations for their program support.

The matrix management operation is designed to give centralized business direction to the large number of diverse functions and programs assigned to a SYSCOM. In this matrix, the technical and administrative experts are located in the functional groups, where they provide direct support to numerous PMs as the needs arise. As a rule, they are not dedicated to a single program, but divide their time among all of the programs that require attention at any given time.

Such organizational structure allows a relatively small number of persons to manage large and complex programs on a long-term, dedicated basis and provides prompt support for these program personnel by specialists located in the individual functional groups. These specialists are exposed to numerous state-of-the-art developments, and have the advantage of a synergistic environment in which lessons learned on one program can be applied toward solving problems on other programs.

Since most of the PM's assistance will come directly from his parent SYSCOM, the detailed NAVMAT and SYSCOM organization charts serve as a useful starting point in determining what help is available and where to find it. The Department of Defense (DOD) phone book is another source of information and is especially useful if the PM desires to determine what assistance may be available from the other services or to compare notes with a fellow PM. Both the Defense System Management College (DSMC) and the Naval Material Command (NMC) Acquisition/Logistics Management Training Center, Anacostia, are available for assistance in management-related problems.

Because of severe manpower constraints placed upon the services and Congress desire to minimize the number of DOD employees in the Washington area, NAVMAT and the SYSCOMs can typically provide only a small number of people to each PM for the necessary day-to-day support. Also, as a result of the general reduction in Headquarters personnel, the "hands-on" experience for which the SYSCOMs were noted in the past is much diluted. The PM (unless he is in charge of a very high priority program) will find himself queuing up with other PMs for essential services. The SYSCOMs do retain sufficient technical talent and insight into program technical management that they can act as a means to gain and integrate field activity support into matrix program management.

Another means for obtaining much needed "headquarters" assistance is to bring in specialized personnel from in-house Navy field stations and Research and Development (R&D) Centers on both long-term and short-term training assignments. The use of the Naval Scientist Training and Exchange Program (NSTEP), for instance, not only supplements the PM's staff, but serves to provide valuable training to the field personnel and improve liaison with the field stations. The Director of Navy Laboratories, MAT-05, can assist in this area.

In recent years, increased use has been made of contractors to assist in the documentation and coordination tasks so necessary to most

programs and to provide technical staff assistance, such as preparing technical documentation. Frequently a contract, which allows for additional task assignments, has already been let for such assistance by the parent SYSCOM. The PM should inquire within his Command as to what assistance contract may be in existence and how he can obtain the needed support services. Some of the advantages, limitations, and controls that affect the use of Contract Support Services are presented later in this section.

Functions that are by their nature restricted to the government must not be allowed to come under contractor control. Similarly, contractor support should not be utilized for matters where government corporate-memory is required. In these areas, every attempt should be made to assign the efforts to a field activity and ensure that the activity is made aware of the need for long-term corporate memory requirements.

Responsive versus Responsible. The PM is the individual ultimately responsible and accountable for success or failure of the program. He must delegate authority to a variety of agencies and individuals within and without the program organization: support facilities, program management office/organization (PMO) members, contractors, etc. Regardless of the amount of authority delegated or the individual or agency to whom it is delegated, the PM does not divest himself of final responsibility and accountability.

The PM has great latitude in assigning responsibility for the various functions required for the successful prosecution of his program. However, certain functions by their nature must be performed within the Government. Among these innately governmental functions are:

1. The determination of needs and the definition of requirements that must be met by the program.
2. Decisions as to operational use.
3. Protection of the taxpayer by the most cost-effective use of available funds.
4. The final decision as to whether or not the end product meets service needs.
5. The overall management of the program.

Government agencies cannot divest themselves of their responsibilities by re-assigning them to non-government agencies through the contracting process. The act of contracting for portions of the program merely represents the assignment of specific responsibilities and the delegation of certain authority to the contractor. While it is essential to the success of the program that these contracts be managed effectively and efficiently, it is equally important that the PMO itself be organized and administered in an effective, efficient manner.

Most programs are managed under the matrix management scheme where-

in the program is run by a small staff of specialists who look to the functional groups and field activities in the specialty areas. Thus the only team members of a given program who are line-responsible to the PM are those on his immediate staff - all others on the program team being line-responsible within the functional groups of the parent command but at the same time being responsive to the PM in accordance with the program organizational diagram.

This concept of being responsible within one organization and at the same time being responsive in an entirely different one is often confusing to the functional group team members and sometimes frustrating to the PMO. However, the benefits accruing to the PM from this type of organization are (1) oversight by the tasked organization of work assigned, (2) assurance that the work conforms to standards in the specialty area, and (3) access to the synergistic advantages of dealing with an organization intimately involved in the specialty field. Functional group and field-activity team personnel know whom they are responsible to and their functional group or field activity homes, but they do not always know to whom they are to be responsive in the program line. In this regard, it is not sufficient to give the simplistic response that all team members must be responsive to the PM. The real question is "Through whom are they to be responsive to the PM?"

Program Management Organizational Structure

PMs have a limited span of control so that it becomes essential that program chains-of-command be established. This can best be done by means of a structured organization, which should be documented by a program organization diagram. To be useful, the organizational diagram must clearly show the program organizational relationships that are intended. There must be no difference between the way the diagram is drawn and the way the personnel interactions occur. It is counterproductive for the PM or any member of his staff to say of the diagram, "This is the way we show it but not the way it really works". If it turns out that there is a discrepancy between the way the organization is shown and the way it works, one or the other should be modified. Organizational anarchy does not typify the well-managed program.

Types of Program Management Organizations (PMOs). Because of limited resources, Navy program management philosophy usually provides for modest permanent staffing of the immediate program office, and requires the PM to obtain support and assistance from headquarters functional groups, Navy field activities, and contractors. The PM should aim for a lean, committed, program staff. One good worker is worth five mediocre ones. It is better to not fill a position than to fill it with someone who cannot, or will not, do the job. The PM should pick his people carefully. The easiest way to manage is to surround himself with good people, and give them the freedom to do the job.

The program must interface effectively with the parent Command. To facilitate this, a matrix-type of organization has proved to be efficient and, with reduced personnel levels, often necessary. In matrix management, the designated PM is the management authority for the pro-

gram and makes all decisions concerning its prosecution. The functional groups in the SYSCOMs, R&D centers, and field activities provide the in-house scientific, technical, contracting, legal expertise, and when called for, detailed management of the participating contractors. Special tasks for the PMO may be performed by field activities or under contract with industry. Among alternative PMO types that have been used successfully are: (1) the fully staffed integral PMO (such as PM-1 or PM-3); (2) a small PMO supported by SYSCOM Headquarters functional groups; and (3) a skeleton Washington SYSCOM office augmented by the technical manager or assistant technical manager and more complete staff at a field station. Figure 2-4 is an example of a PMO combining types (2) and (3); Figure 2-5 is an example of a PMO characteristic of a NAVSEA ship development.

Acquisition Team

The charter will set out, as a minimum, the major initial organizational groupings of the program office and the initial staffing objectives by number, rank, and grade level. A business/financial manager, a logistics manager, a technical manager/system engineer, and a contracting officer will be assigned, however the PM does have some influence on these choices. Compatibility, complementary expertise, and mutual respect between members of the acquisition team are essential.

Additional administrative and program acquisition requirements have placed a serious time-management burden on the PM. As a result, program details frequently do not receive enough attention from the PM. As one solution, a deputy program manager (DPM) may be used. The DPM should be assigned generic duties and responsibilities, and delegated sufficient authority to ease the workload of the PM.

Decision Levels and Assignment of Responsibilities. Since management of a program involves a multitude of decisions of various degrees of complexity and importance, it is obvious that the PM cannot, and should not, try to make all of the decisions. Probably the most effective place for decisions to be made is at the lowest level having the capability and the requisite responsibility and authority to do so. It is important, therefore, that assignment of responsibility and delegation of authority be logically made and carefully defined (the use of the WBS and the accountability matrix in this application is mentioned earlier).

Prefabricated Decisions. In many instances, there are similar situations that arise frequently. These recurring situations should be resolved by established policy rather than by repetitive independent (and possibly contradictory) decisions. Such policies assure uniformity and probably decrease the numbers and complexity and facilitate the making of decisions by lower level managers. Many policies and standards are imposed by the DON and DOD and are promulgated in various instructions and MIL-STDs. Contractors and field activities may also have certain policies that will affect their efforts on the program. It is imperative that the PM be aware of and understand any possible effects of such policies. Additionally, the PM may want to establish

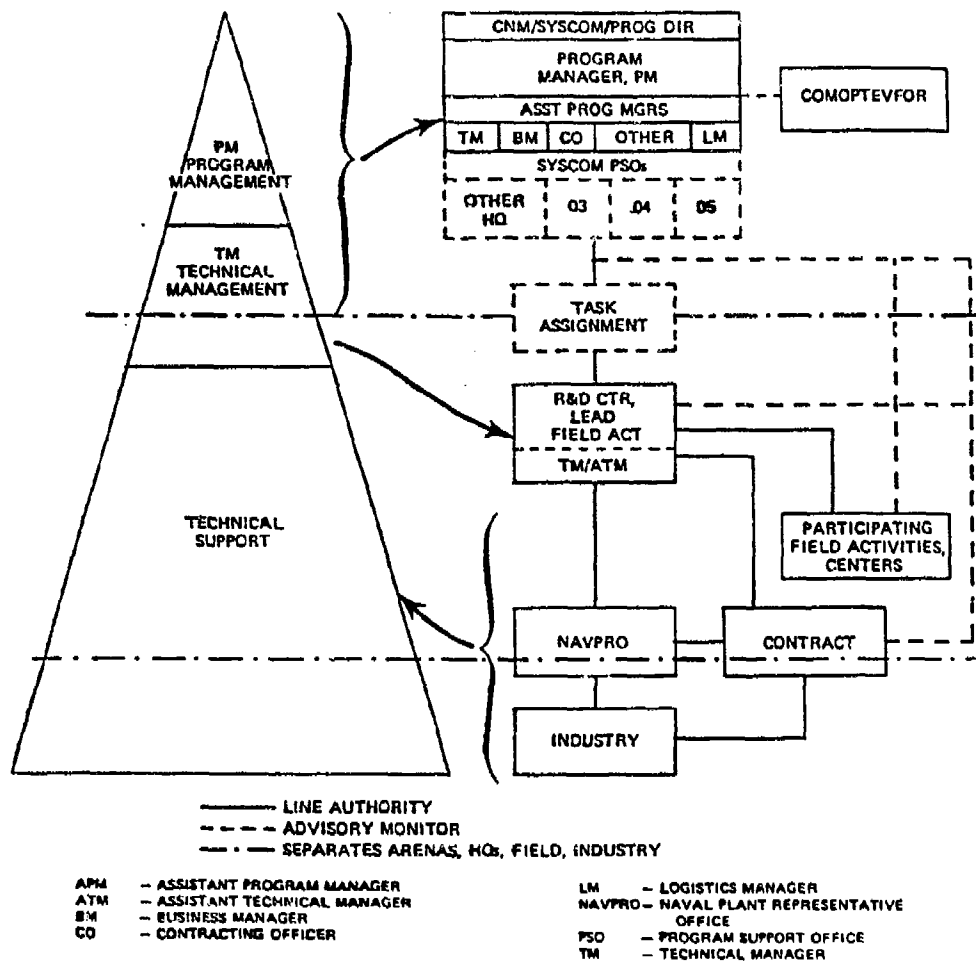


FIGURE 2-4. Sample Program Management Organization.

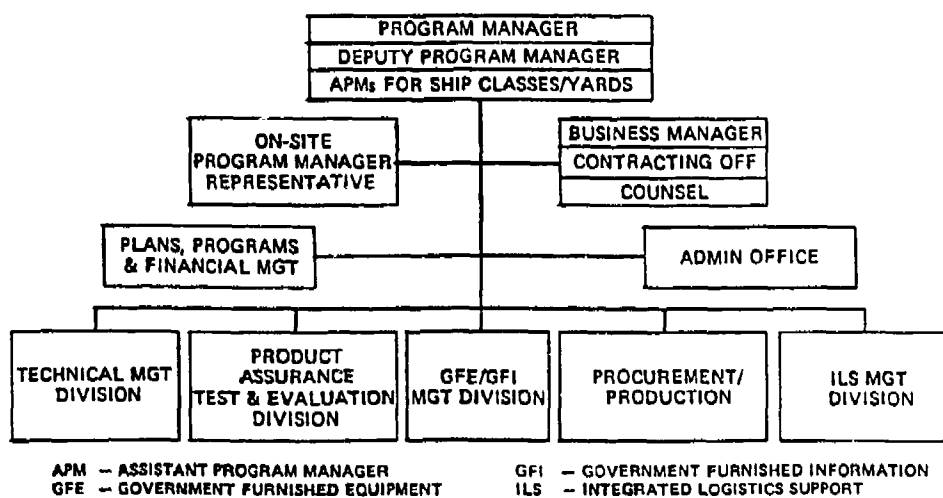


FIGURE 2-5. Typical Ship Program Management Organization.

policies or standards peculiar to his program. If he does so, they should be logical, effective, explicitly defined, and carefully observed; above all, they should not be in conflict with existing DOD and DON directives and instructions.

Relationship of PMO to Other Organizations. The PM must exercise care in setting up the program management organization, in establishing its methods of operation, and in making those methods of operation known to all. Especially critical is the need for establishing direct liaison between the in-house functional organizations and industry. During the competitive Concept Exploration Phase, all contacts between the PMO and the contractors must be carefully controlled to ensure that the participating contractors are treated equally and that competition is not interfered with. In all phases, the PM must insist that the established methods of operation be adhered to. By so doing, he can prevent the contractors and others from making end runs around his technical staff and other in-house support, and thereby undermining their responsibilities and authority. The basic management philosophy of command applies: delegation of authority and limited span of control.

Contractor Team. OMB Circulars A-76 and A-109, as well as the DOD and Department of the Navy (DON) directives and instructions governing the acquisition process, stress the need for government reliance on the private sector, particularly for production and the engineering leading to production. The means for obtaining this support is the contract. The obtaining of a good contract, one that accurately describes the products to be produced, the relationships between the parties, and which is fair to both sides, is critical to the success of the program. Contracting is discussed in more detail in Section 4. Obtaining, monitoring and managing contracts involves the close cooperation of the PM, the business/financial manager, the technical manager and especially the contracting officer. The same procedures for utilizing contractor support will apply to FCRCs and not-for-profit institutions, although these organizations do not have the production capabilities nor the same degree of profit motivation found in the industrial sector.

Contracting Team. The PM must depend upon others to carry out the details for contracting with industry. To this end, he must establish a team of capable specialists. The functions performed by the contracting team and, hence, the size of the team may vary as the program progresses through the acquisition process. The PM must identify the functional makeup of the contracting team and devote a considerable amount of attention to ensuring that the functions are staffed adequately and in a timely manner.

Contracting Officer. There are two interdependent facets to the contracting process that must be given attention by the contracting team - the functional and the technical. The contracting representative on the team is the procuring contracting officer (PCO). The PCO is the official government representative in the contracting process and is responsible for all activities associated with the award of, and performance under the contract. The PCO signs the contract and only he can authorize changes to it. (Actions of other team members may inadver-

tently precipitate changes, but these frequently lead to litigation - a totally unacceptable situation.) While the PM is responsible for the results of the contract effort, the PCO is responsible for assuring that all the contract associated actions are legal, with the result that he often exerts a powerful, sometimes overriding, influence on the contract itself. The PCO, normally, will have other personnel from the auditing and contracting communities assist in the discharge of responsibilities. These personnel will include an administrative contracting officer (ACO), who is generally on-site at the contractor's facility. The ACO acts on delegated authority from the PCO and is usually a representative of the Defense Contract Administrative Service (DCAS) or the Navy Plant Representative Office (NAVPRO). The ACOs and auditors should be brought into the program early to provide the PCO with pre-contract information, cost and price data, and point out the strengths and weaknesses of a particular contractor's proposal.

The PM's close relationship with the contracting team, particularly the PCO and ACO, is important for achieving a smoothly functioning contracting program. The PM should be deeply involved in all facets of the contracting actions involving his program and should act as the chairman for all contracting planning meetings.

The contracting team meet on a regular basis for planning and for reviewing the progress made in implementing the acquisition program. The meetings should be documented and distribution of the minutes should be made promptly.

Team Leaders. Aside from the schedules planning and review meetings, the PM should interface with the contracting team by working with and through team "leaders". Team leaders should be selected and designated for the purpose of coordinating inputs of team members for the various functional areas. The team leader's role is important and should not be bypassed. Although direct communication between the PM and contracting team members is acceptable, the PM should discourage meetings among team members when their team leader is not present. The PM however, should not hesitate to seek counsel from persons external to the designated contracting team for advice or recommendations on appropriate strategies whenever the situation warrants. In some cases, an ad hoc team may be in order.

Contract Administrator DODI 4105.59 established the Plant Cognizance Program. A Navy Plant Representative Office (NAVPRO), Supervisor of Ship Building (SUPSHIP) or other government plant representative office - Air Force Plant Representative Office (AFPRO) or DCAS office - may be established in or near a contractor's plant. They provide contract administration services, and it is essential that the PM and his team coordinate closely with them when dealing with the contractor. Additional services that may be provided include quality assurance inspection and administration, engineering support, production surveillance, price/cost analysis, and property administration. A complete listing of these functions are contained in FAR 1-406. When there is no NAVPRO or other government plant representative office to perform these services, or when particular technical expertise is required in the course of PMO/contractor relations, technical personnel from an in-house R&D laboratory or center are often utilized.

Technical Team. On the technical side, the PM may draw from his own staff, from other groups in SYSCOM Headquarters, or from Navy laboratories/centers to obtain the specialized assistance he may need. Although the number, source and types of specialists called for will vary with the scope and phase of the program, elements of the team are held together for the life of the program and provide continuity and corporate memory for the program. It will include system engineers, experts in specific technologies, specialists in areas such as reliability, production engineering, documentation, fleet in-service support and the like, as well as fiscal and administrative personnel as appropriate.

The technical team provides ongoing analyses and decision-making assistance. On the basis of past experience with related programs, the support team can provide a wealth of knowledge and lessons learned about government/contractor interactions, critical design attributes, survivability features, reliability, human engineering, quality assurance provisions, current technology, safety, and logistic alternatives.

Navy In-House Technical Support. Much of what the Navy has learned from other development programs is available in the Navy laboratories, centers, facilities and stations. The hands-on knowledge and direct user interface experience with both new and old systems resident in these agencies provides a valuable source of expertise. To strengthen this corporate memory and make it easier for the PM and staff to use, NAVMAT and the SYSCOMs have established specific mission areas for each field activity. These laboratory mission areas are described on the following pages and in more detail NAVMATINST 5450.27 and the DON RDT&E Management Guide, NAVSO P-2457. The time required for arriving at technological decisions can be significantly reduced by drawing on these experienced field activity resources.

The Navy laboratory team should be designated as early as possible in the program and should have its assignments of responsibility and delegations of authority defined at the outset. The laboratories should be major contributors to program management decisions that require technical review and assessment. Planning the role of the laboratories should be done on a program-life-cycle basis and permit the laboratories to select the best team members and the most stable organization and methodology to meet the program short-term and long-term needs. The laboratories are a part of the Navy technical team, capable of stimulating and supporting industry, and not a competitor to industry.

Experience has indicated that PMs are frequently unsure of how to best utilize the resources of the Navy in-house R&D centers/laboratories and other field support facilities. This section will discuss their use and tasking. Emphasis is placed on the Navy laboratories because of their full-spectrum capability encompassing personnel, expertise, and facilities for all phases of the acquisition process. They would typically be the first of the support organizations used, transferring duties to the SYSCOM field activities at appropriate times.

The Navy laboratories differ from industrial organizations in that they:

1. Have no profit motive.
2. Are not so directly influenced by the changing demands of the marketplace.
3. Are allowed virtually unlimited governmental-controlled-information access.
4. Have a continued close relationship with the Fleet.
5. Maintain comprehensive technology base in assigned areas.
6. Can be "brought on board" quickly and easily with a task statement.

They also differ from universities in items 2 through 4. The laboratory personnel are actively and intimately engaged in evolving technology in cooperation with universities and industry and thus possess a level of technical leadership not usually found in the other "in-house" organizations.

The laboratories can provide the PM with a fast response to unexpected problems or other urgent matters. This fast response capability as a function of both the speed of the tasking process and the availability of a pool of scientists and engineers with expertise in all disciplines of science, and first-hand knowledge of the technology base.

Laboratories provide technical assistance to PMs in the planning of system development, acquisition, and usage phases, and during the execution of those phases. Assistance includes hand-on development, and management. Because of their extensive experience in the acquisition process, laboratory input to the Source Selection Board is essential in the Mission Area Analysis-Program Initiation Period.

The laboratories provide engineering support at the PM's request during the Production and Deployment Phase. They do this by drawing on their broad base of experience with similar systems in order to solve production problems, particularly during the start-up period when a new contractor is involved. In addition, laboratories ensure a disciplined approach in production support areas such as configuration control, reliability, and quality assurance by closely monitoring the contractor's efforts. Once systems are in operation, the laboratories can provide support (along with the SYSCOM support facilities) to solve in-service problems and to define and carry forward product improvement programs when needed. They can also assist the PMs, SYSCOMs, and support facilities in the preparation of training programs and the planning of logistic support programs.

Perhaps the most valuable contribution of the laboratories, in the initial planning stages, is that they are in a position to evaluate information gathered from all operational systems, together with user reactions, and in turn apply the "lessons learned" to advancements in technology, new acquisitions, operations, and support.

The nine Chief of Naval Material (CNM) R&D centers, along with the Naval Research Laboratory (NRL), the Naval Ocean Research and Development Activity (NORDA) and the Naval Civil Engineering Laboratory (NCEL), serve as the Navy's corporate RDT&E body and are involved in many phases of the acquisition process from maintaining the technology base (research, exploratory development, and advanced development concepts) to

fleet in-service engineering support. Their staffs, which maintain technical expertise and leadership in relevant scientific and technical areas, as well as specialized facilities and test and evaluation (T&E) capability, are ready to serve the needs of the PM.

The CNM-managed R&D centers are specifically tasked under NAVMAT-INST 5450.27 to provide support to PMs during the formative stages and the actual design, development, T&E of new advanced developments, engineering developments, and operational systems developments. In addition, the Technical Director of the cognizant Center may be called upon at Department of the Navy Systems Acquisition Review Council (DNSARC) milestone meetings to give an independent critique of technological risks of the program. In particular, the Centers are expected to assist in the performance of the following functions, as assigned by the sponsor.

1. Provide technical direction during the acquisition process.
2. Prepare and critique the proposed system specifications and the scientific and technical documentation packages that must be provided to industry at the beginning of a competition or new development and participate in the contractor selection process.
3. Assess the risks of alternative approaches
4. Solve specific technical and engineering problems by conducting parallel in-house efforts, or providing technical assistance to contractors.
5. Design and develop selected systems and subsystems.
6. Provide technical leadership for planning and overseeing the integration of new systems.
7. Help prepare T&E plans.
8. Conduct periodic design & progress reviews of work in process.
9. Transition systems to production, including product assurance and production support.
10. Establish and qualify additional sources for procurement.

Federal acquisition policy is explicit in the requirement that the PM consider "...the optimal use of Government laboratories in furnishing technical direction to the contractors during system development." (OMB Circular No. A-109.) While a laboratory may serve in any of the three roles indicated in Figure 2-6, the preferred role and the one that most effectively utilizes the laboratory resources is that of technical manager or assistant technical manager.

NAVMATINST 5450.27 also states that PMs, as a general rule, will designate a lead activity in the early, formative phases of each advanced and engineering development program, to support and assist the pro-

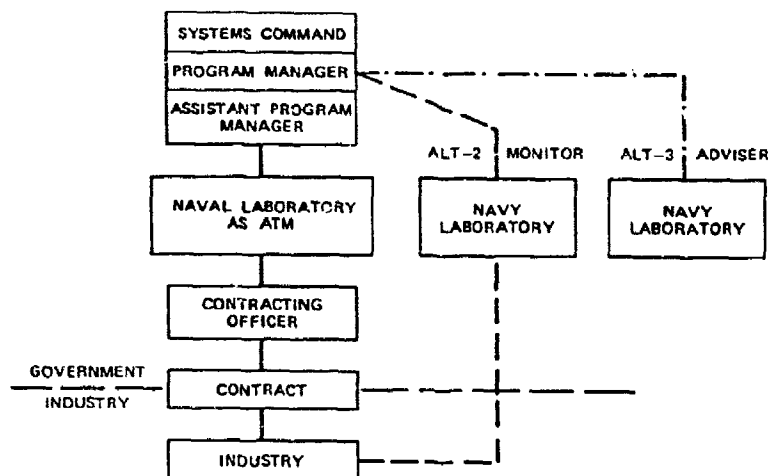


FIGURE 2-6. Alternative Functions of a Navy Laboratory in the PMO.

gram or PM. The Director of Naval Laboratories (DNL), MAT-05 [DCNM(LM)] will be advised of proposed exceptions to this rule. The activity selected as lead will normally be the one with the greatest expertise and experience in the area involved and which can allocate the necessary resources to the effort.

The specific responsibilities to be assigned to a lead activity at any given time in the RDT&E process will be determined by the PM. The mission of the principal centers/laboratories are:

1. David W. Taylor Naval Ship Research and Development Center (DTNSRDC), Bethesda, Maryland. DTNSRDC is the principal RDT&E center for naval vehicles and logistics, provides RDT&E support to the U.S. Maritime Administration and the maritime industry.

2. Naval Air Development Center (NADC), Warminster, Pennsylvania. NADC is the principal Navy RDT&E center for naval aircraft systems less aircraft-launched weapon systems.

3. Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California. NCEL is the principal Navy RDT&E laboratory for shore facilities, fixed surface and subsurface ocean facilities and for the Navy and Marine Corps construction forces.

4. Naval Coastal System Center (NCSC), Panama City, Florida. NCSC is the principal Navy RDT&E Center for mine and undersea warfare, diving and other naval missions that take place primarily in the coastal regions.

5. Naval Ocean Research and Development Activity (NORDA), Bay St. Louis, Mississippi. NORDA is the principal Navy RDT&E activity for ocean science and technology, with emphasis on understanding ocean

processes through measurement and analysis, and the effects of the ocean environment on Navy systems and operations.

6. Naval Ocean Systems Center (NOSC), San Diego, California. NOSC is the principal Navy RDT&E center for command control, communications, ocean surveillance, surface- and air-launched undersea weapon systems and submarine arctic warfare.

7. Navy Personnel Research and Development Center (NPRDC), San Diego, California. NPRDC is the principal Navy RDT&E center for manpower, personnel, education, training and human factors, and for providing technical support to the CNO in these areas.

8. Naval Research Laboratory (NRL), Washington D.C. NRL conducts broadly based multi-disciplinary program of scientific research and advanced technological development directed toward new and improved materials, equipment, techniques, systems and related operational procedures for the Navy.

9. Naval Surface Weapons Center (NSWC), Dahlgren, Virginia. NSWC is the principal Navy RDT&E center for surface ship weapon systems, ordnance, mines, and strategic systems support.

10. Naval Training Equipment Center (NTEC), Orlando, Florida. NTEC conducts RDT&E and procurement of training equipment, systems, devices, simulators, and aids.

11. Naval Underwater Systems Center (NUSC), Newport, Rhode Island. NUSC is the principal RDT&E center for submarine warfare and submarine weapon systems.

12. Naval Weapons Center (NWC), China Lake, California. NWC is the principal Navy RDT&E center for air warfare systems (except ASW systems) and missile weapon systems and the national range/facility for parachute test and evaluation.

One of the distinct advantages of the in-house Navy RDT&E facilities is the ease with which they can be tasked and hence the ease which work can be initiated or halted. Tasking through work unit assignment varies slightly from SYSCOM to SYSCOM but the procedures are well established and simple. Face-to-face discussions are held to determine exactly what the PM wants done and the responsibility to be assigned. Unlike contractual obligations negotiated with industry, changes can be readily made without the time-consuming planning and negotiating normally associated with Request For Proposals (RFPs), Request for Authority to Negotiate (RANs), Determination and Findings (D&Fs), etc. Since both the PM and the RDT&E facility are motivated by a desire to accomplish Navy goals, there are considerably less grounds for disagreement than in PM/contractor dealings.

Because of imposed personnel ceilings and the requirements for the R&D centers to accept new R&D assignments and maintain a balanced workload, it may be necessary for them to transition work to the specialized SYSCOM field activities at appropriate stages of development. Transfer is typically initiated near the end of full-scale development (FSD) and

completed after the first full-volume production. It is essential for the PM to allow and encourage such transfer.

The various SYSCOM field activities and T&E facilities also play vital support roles in the development, test, and evaluation of new systems. Unlike the CNM R&D centers, the SYSCOM field stations typically are not full-spectrum activities but are more highly specialized with expertise in the support of fielded systems. Like the CNM R&D centers, they may be easily tasked by the PM to provide the amount of support needed in the particular area of specialization.

Representative SYSCOM field activities and T&E facilities:

1. Atlantic Undersea Test and Evaluation Center (AUTEC), West Palm Beach, Florida. AUTEC provides a deepwater T&E facility for ship, sensor, and underwater weapons systems.
2. Atlantic Fleet Weapons Training Facility (AFWTF), Roosevelt Roads, Puerto Rico. AFWTF supports development and testing of ship and air weapons systems and fleet training.
3. Marine Corps Development and Education Command (MCDEC), Quantico, Virginia. MCDEC performs RDT&E for Marine Corps doctrine and equipment.
4. Naval Air Engineering Center (NAEC), Lakehurst, New Jersey. NAEC conducts RDT&E for aircraft launching and recovery support systems and ground support equipment.
5. Naval Air Propulsion Center (NAPC), Trenton, New Jersey. NAPC performs T&E of aircraft propulsion systems.
6. Naval Air Test Center (NATC), Patuxent, Maryland. NATC performs T&E of aircraft and weapons systems and ground support equipment.
7. Naval Avionics Center (NAC), Indianapolis, Indiana. NAC conducts R&D, acquisition, and integrated logistics support on airborne electronics, missiles and weapon systems and equipment.
8. Naval Ordnance Station (NOS/IH), Indianhead, Maryland. NOS/IH provides material and technical support for weapon systems, weapons, and components as directed by the Commander, Naval Sea Systems Command.
9. Naval Ship Weapon Systems Engineering Station (NSWSES), Port Hueneme, California. NSWSES conducts T&E of developmental and upgraded combat and weapon systems for surface combatants. It is also the In-Service Engineering Agent for surface Navy AAW and ASUW systems.
10. Naval Weapons Support Center (NWSC/C), Crane, Indiana. NWSC/C provides material, technical and logistics support for ships and crafts equipment, shipboard weapon systems, and expendable and non-expendable ordnance items (principal Navy RDT&E for pyrotechnics).
11. Naval Weapons Evaluation Facility (NWEF), Albuquerque, New Mexico. NWEF performs T&E and provides technical support for nuclear

and special weapons systems.

12. Pacific Missile Test Center (PMTTC), Point Mugu, California. PMTTC provides range facilities, RDT&E, and support for DOD missile, satellite, and space vehicle programs.

Commander, Operational Test and Evaluation Force (COMOPTEVFOR). For ACAT I, II, III, and IVT programs, for which a TEMP and operational testing is required, early coordination with COMOPTEVFOR is advantageous and strongly recommended. As the Navy's independent agent for operational test and evaluation (OT&E), COMOPTEVFOR is charged in OPNAVINST 5440.47 with:

- o Reviewing the test and evaluation (T&E) planning for new weapons systems and reporting to CNO on the adequacy of the plan to address and resolve critical issues
- o Evaluating the operational effectiveness, suitability, and capability of tested weapon systems to meet stated needs and performance criteria
- o Developing tactics and procedures for the employment of specific weapons systems

It is essential that COMOPTEVFOR be involved in the acquisition program early in order to carry out these responsibilities. This early involvement can be of great assistance to the PM as COMOPTEVFOR's experience provides an invaluable source of information concerning program structure, dos and don'ts, and both general and detailed planning.

Contract Support Services

Often a PM finds it necessary to contract for consulting services, studies, or other professional and management support services not available through his staff, SYSCOM, or supporting field activity. SECNAVINST 4860.44C (Commercial and Industrial Activities) establishes Navy policy of relying on the private enterprise system to the maximum extent that such reliance promotes effective accomplishment of essential programs. Care is required, however, to ensure that contract support services are not used to contract for personal services not authorized by law, or to circumvent competitive civil service procedures and Classification Act pay limits.

In the past, several nonpersonal-service contracts have been ruled illegal or have come under congressional scrutiny. As a result, the Office of Personnel Management and Comptroller General have issued several decisions which state, in essence, that the proper use of nonpersonal contract support services involves meeting two conditions: the contract must ask for the finished product, and the contract must be administered in such a way that control and supervision over the work and the discretion as to the techniques used remain solely with the contractor. The Navy has also issued amplifying instructions to enable more effective use of contract support service and to prevent their misuse.

SECNAVINST 4200.27 ("Contract Support Services: Planning and Administration") was issued to ensure that all Navy personnel having responsibilities related to contracts for support services understand the limitations upon the use of such contracts, the difference between personal and nonpersonal services, and the factors that may render otherwise proper contacts illegal.

NAVMATINST 4200.50 ("Use of Contractor Support Services") was issued to ensure that use of commercial sources to supplement internal resources in the planning, conduct, and evaluation of assigned missions and related programs does not compromise or weaken the Navy's fundamental responsibility for controlling and managing Navy programs. A partial listing of specific work that should not be performed under contract includes program planning, budgeting, and fund allocation (for example, preparation or maintenance of budgets); military, business, and acquisition strategy planning (for example, preparation of POM's); and contract negotiation and award (for example, preparation of business clearances).

Legal review and Flag or Senior Executive Service (SES) approval are required only when obligations will total more than \$50,000. A review by counsel of those requirements under \$50,000 may be requested when appropriate. Contract obligations of more than \$25,000 must be reviewed by counsel for nonpersonal-services determination. If the contract award is noncompetitive, and the estimated total dollar value exceeds \$1 million, approval by the DON Oversight Manager (MAT-02B) is required.

Section 3

THE ACQUISITION PROCESS

Section 3

THE ACQUISITION PROCESS

PROGRAM INITIATION

Mission Area Analysis (MAA)

MAA, technology base development, internal political influences and the mission need determination lead to program initiation. Although these factors collectively are not considered as a phase of the acquisition process, and though they occur prior to the designation of a program manager (PM), it is important that the PM understand their nature and scope.

DOD Directive (DODD) 5000.1 cites analysis of mission areas as a means for the services to identify deficiencies or opportunities that could lead to the initiation of a major systems acquisition program. The Navy, however, does not routinely carry out such analysis. More typically, OP-095/090 will carry out analyses at the request of the Chief of Naval Operations (CNO) or if requested by sponsors for a program in which they are interested and for which they are willing to spend their limited dollars. Hence much of the initial MAA is carried out by Navy Research and Development (R&D) centers or by industry as part of independent research and exploratory development programs.

Basic Requirements for a New Start

The basic requirements for the start of a new acquisition program are a program initiation document and the allocation of funds.

The program initiation document identifies a specific deficiency in the mission area, the relative priority assigned to correcting the deficiency, and an estimate of the magnitude of resources necessary to correct the deficiency. Unlike operational requirements documents of the past, which tended to describe general requirements, the program initiation document should define the deficiency as narrowly as possible so that there is a reasonable probability of correcting it by developing a single system. However, solutions to the problem should not be specified.

Approval of the program initiation document - included along with the Program Objectives Memorandum (POM) submittal in the Planning, Programming, Budgeting System (PPBS) - constitutes permission to move ahead into the Concept Exploration Phase once money has been appropriated or reprogrammed. The requirement to include the new start within a constrained Navy budget (thereby subjecting it to the inevitable competition for funds) strongly influences the program initiation process.

It is probable that during the course of preparing the proposed program initiation document and getting it approved, compromises and changes were made in the proposed document. While this process may take place before the PM's "watch", he should find out and document these

compromises and changes so that previously resolved issues will not be resurrected whenever a new PM appears on the scene. He should also know where, in the in-house R&D laboratory/center and industrial communities, the technical expertise has been developed and what other programs and funding claimants are competing for the same fiscal and manpower support. MAT-05 can provide assistance to the program manager (PM) in selection of the development lead laboratory.

Documentation Requirements for Program Initiation

There are five documents used by the Department of the Navy (DON) during the program initiation process; they are:

Tentative Operational Requirement (TOR). The TOR describes a need for a new system as perceived by the Office of the Chief of Naval Operations (OPNAV). The TOR describes the desired capability in general terms. When numbers are used they are to be in broad ranges. The TOR is limited to three pages. See OPNAVINST 5000.42B for the required TOR format.

Development Options Paper (DOP). The DOP is a Naval Material Command (NAVMAT) reply to a TOR and is based on the exploration of options. The DOP describes a range of possible systems covering a spectrum of capabilities. The DOP should be as short as possible with the TOR appended. See OPNAVINST 5000.42B for the required DOP format.

Operational Requirement (OR). The OR describes the major characteristics of the alternative selected by the OPNAV sponsor, as a result of the review of the DOP, which best matches the desired capabilities within affordability limitations. The OR is limited to three pages. See OPNAVINST 5000.42B for the required OR format.

Required Operational Capability (ROC). The ROC is used to document a Marine Corps need and is a brief statement of a specific operational capability. See Marine Corps Order (MCORD) 3900.4 for the required ROC format.

Justification for Major System New Start (JMSNS). The JMSNS serves, for major systems, the same purpose as the OR and ROC do for other-than-major systems. The JMSNS is limited to three pages. See DOD Instruction (DODI) 5000.2 for the required JMSNS format.

Influences on the Program Initiation Document

Development of a JMSNS, OR, or ROC is influenced by other factors. Among these are the effects of technical innovation, the evolution of the document within OPNAV, and the competition for funds within the PPBS.

Technical Innovations. During a period which may cover several budget cycles, advanced system and building-block concepts are evolved either by Navy- and DOD-sponsored research and technology programs or independently, by industry and academia. These concepts may form the

technology drivers for a JMSNS, OR, or ROC.

The typical route for major development proposals has been for the entrepreneur (in government or industry) to convince the responsible office within NAVMAT or a Systems Command (SYSCOM), or an OPNAV sponsor, of the value of the advanced concept and the desirability of direct funding prior to submittal of the need document. As a result, a line item (6.3A) may be established in the Five-Year Defense Program (FYDP) to fund the further technological advances necessary to develop the concept, to conduct in-depth analysis of its utility, and/or to conduct technical demonstrations of the concept. More often, Funding for this work is provided within an appropriate existing program element.

Advanced Development Project Office (ADPO)

Frequently, an ADPO and team is established within the appropriate System Command (SYSCOM) office to coordinate and manage the effort, as in the example shown in Figure 3-1 on the next page. The program officer in charge is thus in a position to assist the OPNAV sponsor in writing the appropriate requirements document and processing it through the approved chain. Often the program officer will rely completely on the existing SYSCOM structure and the in-house R&D laboratories/centers, coordinated through a lead R&D center, for the technical support and technical management of the major contracts. This is particularly advisable if the lead laboratory/center has been involved in creating the technology base upon which the system concept is founded. An advantage of the ADPO is that the skeleton of a program management office (PMO) is already set up and working by the time the program initiation document is approved and the program manager (PM) is formally appointed and chartered.

Program Initiation Document Evolution within OPNAV. The process by which a JMSNS, OR, or ROC is generated within the OPNAV is shown in Figure 3-1. A simple diagram, however, cannot convey the fact that both OPNAV and the larger DOD organization within which it operates are composed of people with varying degrees of strength, influence, interest, and efficiency. The path leading to the proposed JMSNS/OR/ROC in a given program may not have touched all the functional units shown here - some being more critical than others.

The phrase "other influences" in Figure 3-1 represents a host of organizations and forces that bear upon the preparation of a JMSNS/OR/ROC. Among these are the Secretary of the Navy (SECNAV), the Office of the Secretary of Defense (OSD), the Organization of the Joint Chiefs of Staff (OJCS), industry, the North Atlantic Treaty Organization (NATO) interests, and Congress. The strength of a particular organization's influence will depend on the existence within that organization of a powerful advocate with a strong voice.

It is useful for the PM to know the supporter of his program at every level since their continued support is vital to the program. If the PM will ensure that these supporters are at all times appraised of the program status, he will likely enjoy their continuing support. Some

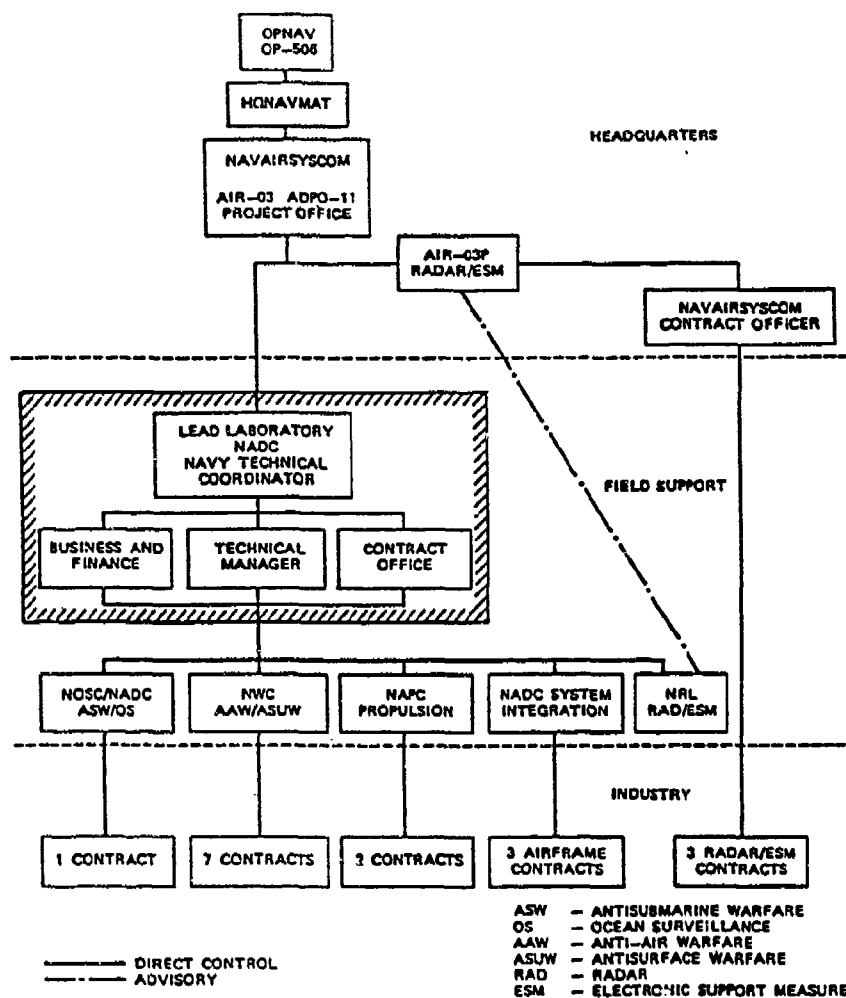


FIGURE 3-1. Advanced Development Project Office (ADPO).

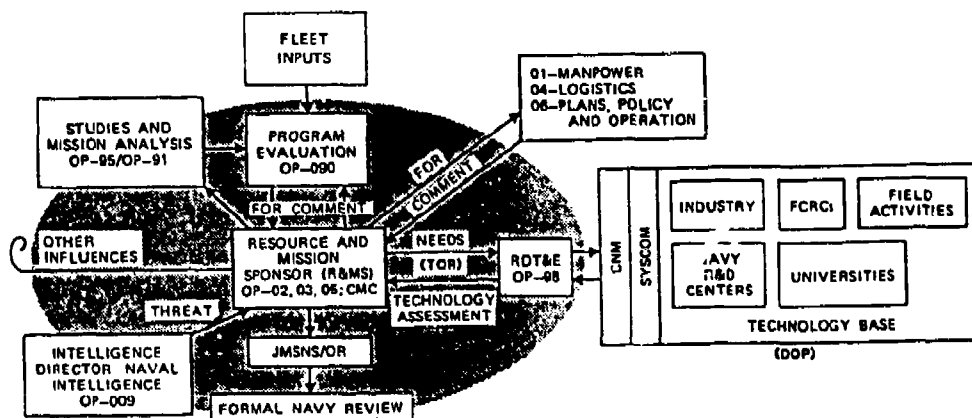


FIGURE 3-2. Need Document Evolution within OPNAV.

care ~~must be~~ taken in how the information flow from PM to his supporters is maintained. The Navy requires that contacts with offices and personnel in OSD be made through the program coordinator or development coordinator in OPNAV, and that contacts with Congress be carried out only through the Congressional liaison office. Although assignment as a PM does not remove one's constitutional right to speak to his representative or senators in Congress, such contacts (when they reflect on his program) should be made with extreme caution and preferably with the advance knowledge of superiors and sponsors. End runs around "the system," while sometimes effective, can also backfire and ruin a career.

Joint Service Programs

Joint service programs are instituted for operational and/or economic reasons, e.g., simplification of logistic operations or improvement of combat capability. They are strongly supported and encouraged by OSD and Congress. Rarely are acquisition programs joint from their inception and few programs become joint without some initiative by the Secretary of Defense (SECDEF) or the Congress. Most are preceded by individual service efforts, often after much R&D has been accomplished.

Typically, the Under Secretary of Defense for Research and Engineering (USDR&E) will write a memorandum designating one service as the lead (or executive) service and directing it to charter a joint program office. The services negotiate the ground rules of the joint program and agree to assignments of program authority, responsibility, and funding. When a decision is made to initiate a joint service program as a result of an approved JMSNS, designation of the lead service is made by the SECDEF in a SECDEF Decision Memorandum (SDDM).

Interservice negotiation and agreement on a joint program may occur at any one of several echelons: the service secretariats, the service headquarters, the material development and logistics commands, or their commodity-oriented subcommands. Interservice agreements are normally made between organizations of the same level.

There are two advantages to agreements at the service headquarters level. First, it is the level at which operational needs are validated and translated into equipment needs. Second, it is the level at which funding priorities are established. Nothing is more important to the success of a joint program than interservice agreement on needs and funding. The major disadvantage of inter-headquarters agreements is the length of time required for staff consideration.

Agreement at either the service headquarters or secretariat level is usually documented by a memorandum of agreement (MOA). There is no typical format for an MOA. It may define all the ground rules for the joint program, much as a charter would, or it may be brief, covering only key areas of agreement. Frequently, a program will have several MOAs associated with it, each covering a different topic.

The basis for joint programs is DODI 5000.2 and a MOA signed by the Joint Logistic Commanders in 1973 (Management of Multi-Service Systems/Projects/Programs, NAVMATINST 5000.1A). For a comprehensive study of

joint program management, the reader is directed to the Joint Logistics Commanders' Guide to the Management of Joint Service Programs, published by Defense Systems Management College, Fort Belvoir, Virginia 22060.

NATO Standardization and Interoperability & Foreign Military Sales (FMS)

Two other factors may strongly influence the MND and the subsequent system acquisition: requirements by DOD and DON for achieving standardization and interoperability of weapons and equipment within the NATO, and the Security Assistance Program, especially foreign military sales (FMS). SECNAVINST 5000.1 provides direction that consideration must be given to NATO rationalization, standardization and interoperability (RSI), as well as reciprocal procurement or offset agreements with friendly foreign countries. Further, detailed requirements for NATO RSI are given in DODD 2010.7 and DODD 2010.6 as well as SECNAVINST 5711.10. The PM should note that NATO RSI must be considered during the acquisition process and addressed at each acquisition milestone.

Security assistance provided to foreign countries by the U.S. consists of international military education and training (IMET), grant aid, and military export sales. Sales are either commercial (direct procurements by a foreign country from U.S. private sources) or FMS (sales by the U.S. government to a foreign government). Both FMS and commercial sales may include licensing, co-production, or offset arrangements. Specific responsibilities, policies, and procedures are set forth in DOD 5105.38M, Military Assistance and Sales Manual (MASM). This manual is the principle source of information and instructions for administering the U.S. military assistance and FMS programs. Additional guidance is set forth in NAVMATINST 4900.22, the Naval Material Command Security Assistance Program and Support Planning Manual. While prospects for FMS can affect a program's initiation and provide some funding for R&D, its greatest impact usually occurs after major development has been accomplished and the program is ready to enter into production. Security assistance programs have their own funding, configuration control, quality assurance problems, etc., as well as their own reporting channels from SYSCOMs through to the Assistant Secretary of Defense for International Security Affairs [ASA(ISA)]. One of the principle advantages accrued to the program and the U.S. is the reduction in unit costs during production as a result of larger buys than can be supported by the Navy or DOD alone.

Preparing the Program Initiation Document

Formal Process. Figure 3-3 on the next page illustrates how a Navy-oriented JMSNS/OR is conceived and staffed through the system. The staffing of the JMSNS and OR differs primarily on the level of review required and who signs off or approves the program.

Guidance from the SECDEF, the Joint Chiefs of Staff (JCS), intelligence sources, as well as inputs from the Fleet, are provided to the Fleet commanders, OPNAV sponsors, and acquisition managers in OPNAV and NAVMAT. The information is used to gauge needs, capabilities, and

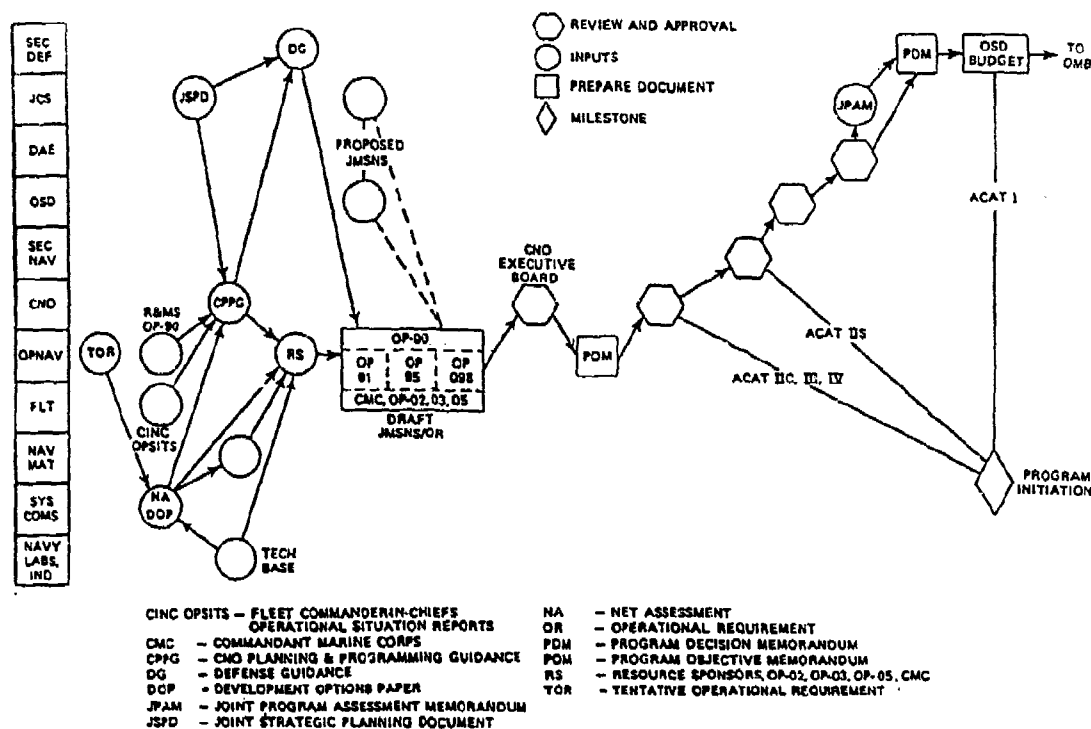


FIGURE 3-3. Preparing the Program Initiation Document.

ongoing developments in the Navy mission areas in order to assess specific unfulfilled operational needs.

These needs are presented to OPNAV, which conducts MAA and, if a need is substantiated by the analysis, the OPNAV sponsor prepares a TOR and transmits it to NAVMAT. The TOR describes the need (desired capabilities) in general terms.

In reply to the TOR, the cognizant SYSCOM develops a DOP which is coordinated and distributed by NAVMAT. The DOP outlines a complete menu of systems, from those of minimum capability, cost, and time - including upgrades of existing systems - to advanced systems of great capability and cost, with much later initial operational capability (IOC).

The OPNAV sponsor selects the alternative to be pursued and originates a JMSNS/OR. If the alternative chosen is determined to represent a major system (Acquisition Category (ACAT) I program), OPNAV documents that need in a JMSNS. The OJCS and OSD may also prepare the JMSNS in DON mission areas. If the need is estimated to represent a program other than ACAT I (i.e., an ACAT IIS, IIC, III, or IV), OPNAV documents the need in an OR. Marine Corps needs are treated in a similar fashion with staffing done within Marine Corps Headquarters with assistance from the Marine Corps Development and Education Center (MCDEC), the SYSCOMs, and OPNAV. Documentation for Marine Corps programs is similar, i.e., JMSNS for ACAT I programs and a ROC for all other ACATs.

Informal Process. The actual manner in which a new program is started often differs from the formal process described. For example: as part of an in-house technology base program (or an aerospace firm's independent research and development (IR&D) program), a Chief of Naval Material (CNM)-commanded R&D center determines that a new anti-air missile is both feasible and desirable. The first step is to find an advocate within the appropriate OPNAV sponsoring code, e.g., OP-05 for an air-launched system. It is well to have first enlisted support for the new missile within the appropriate supporting SYSCOM.

Someone in the sponsor's code (perhaps with assistance from the center/entrepreneur) will need to prepare a POM issue paper covering the proposed new start. The paper will include an abbreviated (one page) version of the proposed need document and describe what the new system is supposed to do, the threat, existing systems to be replaced, the approximate costs of the system, and the amount of money required for the Five Year Defense Program (FYDP) period.

This issue paper is then reviewed within the OPNAV sponsor's group to determine whether the proposed system is affordable, where the needed money can be obtained [i.e., at the expense of what other program(s)], and what the relative priority of the program should be within the gamut of programs being sponsored.

The sponsor (with assistance of OP-501 in this case) then prepares a Sponsor Program Proposal (SPP) and a Mini-MIP (a short version of a Navy RDT&E Management Information Paper), the latter prepared jointly by OP-982 and the appropriate sponsor in OP-05. These steps are necessary both for a program to be added to an existing program and for initiating a completely new program. Once these steps have been completed, the proposed new start is processed like any other POM submittal. A TOR, DOP and OR would be prepared later after the concept feasibility had been proven.

Program Initiation Review and Approval

Each phase of a Navy acquisition program is subject to one or more reviews by successively higher echelons before the designated PDA renders a decision. The purpose of phase review is twofold. First, it ensures that all areas of uncertainty (need, technical, fiscal) are carefully considered and evaluated before a commitment is made to proceed to the next phase. Second, it gives the review and PDAs the opportunity to make sure that the mission need is still valid and that the program initiation document accurately reflects the organizational view of the need. Appendix A provides a step-by-step description of the program initiation process.

The JMSNS/OR is routed via OP-01, OP-04, and OP-090, approved by OP-095 (OP-06 for strategic nuclear systems) and promulgated by OP-098. High-cost or controversial programs will be concurred in by CNO/Vice Chief of Naval Operations (VCNO) prior to approval of the JMSNS/OR. OP-090 will decide whether this is accomplished by the CNO Executive Board/Acquisition Review Committee/Ship Characteristics and Improvement Board (CEB/ARC/SCIB) or directly by OP-095(OP-06).

Once the program initiation document has been approved, it is incorporated by OPNAV/HQMC as a line item in the next DON POM. Approval of the proposed POM by the CNO or CMC provides the program start decision, endorses the OR or ROC, and allows an ACAT IIC, III or IV program to enter the Concept Exploration Phase after budget approval.

The proposed POM is then submitted to the SECNAV for review and approval. Approval of the POM with a line item representing an ACAT IIS program endorses the OR or ROC, and allows the ACAT IIS program to enter concept exploration after budget approval.

The POM is then submitted to the SECDEF for review and approval. If the SECDEF endorses a new start represented by a JMSNS, inclusion of the new start in the DOD budget submitted to OMB documents that endorsement and provides the program initiation decision. This endorsement allows the ACAT I program to enter concept exploration when the budget is approved.

When the JMSNS proposed program is modified by SECDEF, the modifications are documented in the PDM, the SECDEF's reply to the POM. When a Joint or OSD/JCS JMSNS is submitted, the SECDEF decision is documented in an SDDM.

Interfacing with the PPBS

The DOD PPBS, as defined in DODI 7045.7, is the framework within which SECDEF and SECNAV decisions are made to determine force levels, weapons systems, and support programs. Major decisions for individual projects are made in the context of both the acquisition process and the PPBS. The PPBS is described in great detail in The Department of the Navy Programming Manual prepared by OPNAV-90P. A short course covering the system is given by OSD at the Pentagon. Further information on this course, which is recommended, may be obtained from the NMC Acquisition/Logistics Management Training Center, Naval Station, Anacostia, Washington D.C. 20374.

The acquisition process proceeds in phases, each of which may require only a part of a budget cycle or several full cycles. Gearing the phases to the particular business and technical aspects of the program ensures that adequate in-depth reviews are conducted prior to significant commitment of resources. By contrast, the PPBS runs on a tightly structured schedule - a single cycle from initial planning through congressional enactment to actual execution requires 25 months. The PPBS decisions, rather than being oriented to the needs of a specific program, are keyed to the larger problem of balancing all of the programs within the DON, DOD, Office of Management and Budget (OMB), and congressional financial limits established for a particular fiscal year of the (FYDP).

Decisions made through the acquisition process need to be reflected in the FYDP. This is accomplished either during the POM/Issue Paper/PDM process, or during the budgeting process, depending on when the milestone decision is made. The PM must follow these processes carefully

because his program funding is in jeopardy at each step of the budgeting process. Successfully passing a milestone decision is no guarantee of full funding, and in the POM/PDM/budget process the program's funding may be dropped below threshold.

Defense Resources Board (DRB). Top level DOD review of the POM/budget is the responsibility of the Defense Resources Board (DRB). The membership of the DRB, based on a Deputy Secretary of Defense Memorandum dated 27 March 1981, includes:

Chairman: Deputy Secretary of Defense

Members: Chairman of the Joint Chiefs of Staff

Secretary of the Army

Secretary of the Navy

Secretary of the Air Force

Under Secretary of Defense, Policy

Under Secretary of Defense, Research and Engineering

Assistant Secretary of Defense, Comptroller

Assistant Secretary of Defense, Health Affairs

Assistant Secretary of Defense, International Security
Affairs

Assistant Secretary of Defense, International Security
Policy

Assistant Secretary of Defense, Manpower, Reserve Affairs
and Logistics

Director, Program Analysis and Evaluation

Associate Director, Office of Management and Budget

The makeup of the DRB is very similar to that of the Defense Systems Acquisition Review Council (DSARC), although their purposes are different. The DRB review can severely impact the budgeting of major systems acquisition, as occurred with the F/A-18. The DSARC deals with a single system at a time, basing decisions on the technical progress, acquisition strategy, implementation plans, and accuracy of cost projections. By contrast, the DRB's responsibility is to advise SECDEF on the overall DOD budget. In this area, each program must compete with all other programs (including those of other Services) for dollars. The DRB recommends to SECDEF a priority and ranking of programs.

In the event a POM or budget submittal to OSD deviates significantly from a previously approved milestone decision, this fact and the cost, schedule, and performance impact on the program are to be noted and explained in the POM or budget submittal. In such instances, the milestone decision is a decision alternative in the POM or budget.

Figure 3-4 outlines the PPBS sequence. The effect of this interrelationship between the PPBS and an acquisition program is that adequate funding for the critical Concept Exploration Phase is unlikely to occur until 18 to 24 months after the need document submittal and at least 12 months after its approval unless reprogramming is carried out. A step-by-step description of the PPBS is also provided in Appendix B.

DOD officials are investigating the possibility of establishing OSD or DOD discretionary funds for Concept Exploration Phase funding. For

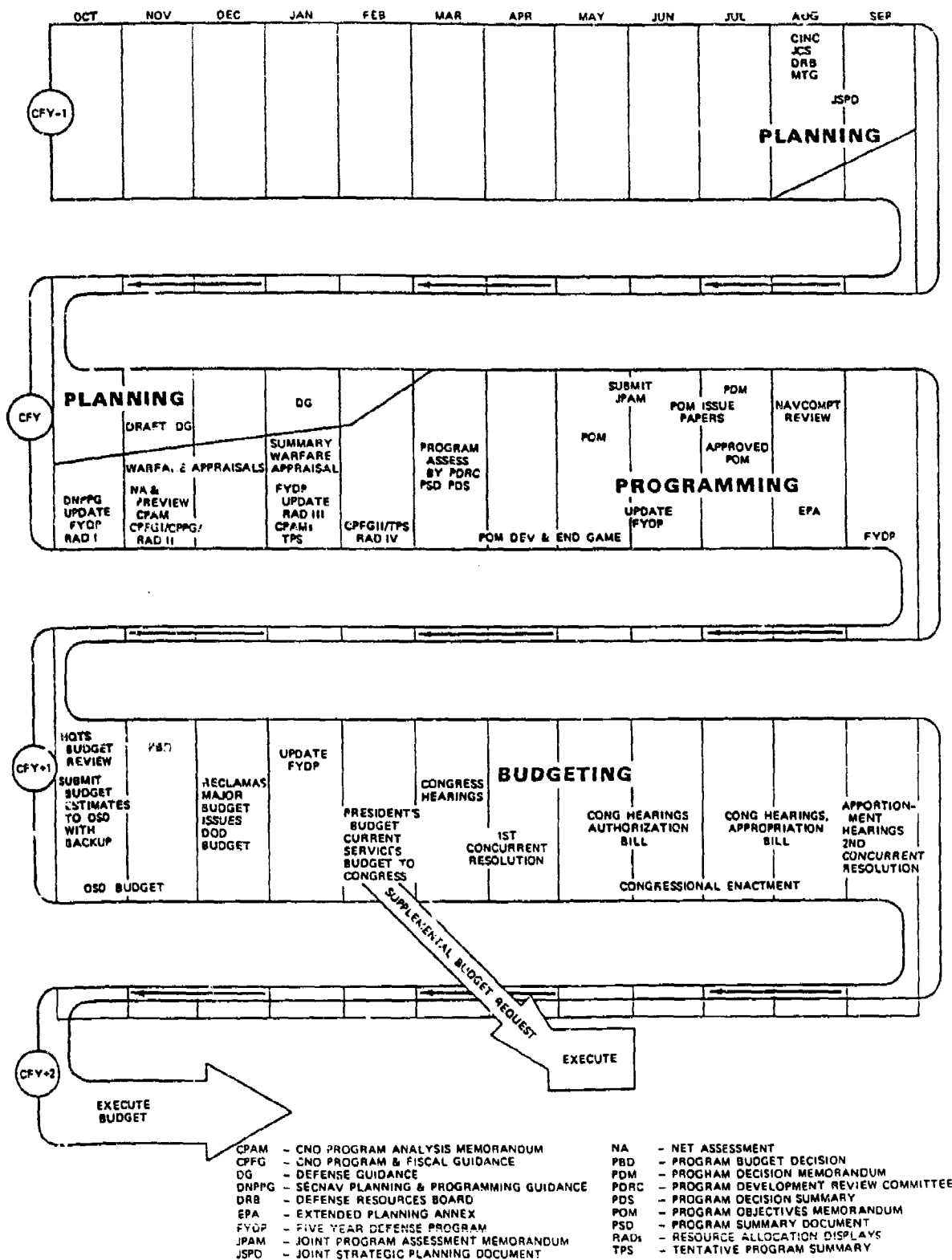


FIGURE 3-4. Sequence of PPBS Events.

the present, however, the PM must establish and maintain contact with constituent groups and individuals in the DON who have an interest in the program and from whom he might obtain the necessary support for reprogramming action.

The problem of obtaining adequate funding during the Concept Exploration Phase can be reduced by advanced development or exploratory development funds into the mission areas that will directly support an anticipated new start.

Since the PPBS is an annual event, and there is continuing competition by many programs for the same funds, the PM must maintain an awareness of the status of the budgeting process and be prepared at any time to support his OPNAV sponsor and program coordinator in defense of his project's funding. When responding to questions or writing appeals, the PM and program coordinator must work as a unified team. CNM laboratory and contractor support may also be helpful. Sensitivity to the perspective of the questioner is vital.

The PM should anticipate budgeting problems. Alleviating these can be one of the most urgent problems he will face. He must know the probable opposition and, with the OPNAV program coordinator, maintain a forceful dialogue with important constituencies, particularly within the Office of the Comptroller of the Navy (NAVCOMPT).

Significance of the Program Initiation Decision

Preparation of a program initiation document indicates that a specific deficiency or opportunity in the Navy's mission capability has been identified and approval is sought to take appropriate action. When a JMSNS is submitted to SECDEF, the DON requests that the program be given ACAT I designation. Other programs may, however, be submitted for SECDEF review if the DON feels that their significance so warrants. Submission of such a JMSNS to SECDEF constitutes a recommendation by the Navy that the designation of an acquisition as a "major system" may be based on the critical nature of the deficiency, the amount of fiscal and manpower resources required for a major system's acquisition and operation, the urgency of need, development risk, joint acquisition consideration (interservice, NATO, etc.), or congressional interest.

SECDEF, by approving a DON budget that includes the JMSNS program, signifies his agreement with the statement of need and with the assessment of the system as major. His approval also directs the Navy to undertake exploration of the various means of correcting the deficiency. SECDEF may also decide that a program represented by a JMSNS should be designated non-major. In such a case, the JMSNS is returned to the DON for action and, based upon criteria in SECNAVINST 5000.1, assigned to the PDA for action. The program initiation decision defines a starting point from which to audit cost and schedule performance. SECDEF approval establishes a firm DOD position relative to the mission need and signifies an intent to satisfy that need. For ACAT III and IV programs, Milestone I will normally be eliminated and approval of program initiation in the POM authorizes entry into the Demonstration and Validation (D&V) Phase unless otherwise directed..

CONCEPT EXPLORATION PHASE

The program initiation documentation and approval of the budget marks the beginning of the Concept Exploration Phase during which alternative concepts are solicited, proposed, and selectively evaluated. During this phase, industry and in-house R&D laboratories/centers, as well as universities and other not-for-profit institutions, are challenged to conceptualize and submit alternative methods for meeting the stated mission need. In addition, in-house studies must be initiated for independently arriving at performance, cost, schedule, and supportability estimates as well as test and evaluation (T&E) criteria. Figure 3-5 is an overview of the inputs, principal activities, and outputs of the Concept Exploration Phase.

Concept Exploration Phase Objectives

The objectives of the Concept Exploration Phase are the selection of the most promising system concepts for the Demonstration and Validation (D&V) Phase and initial preparation of plans for the balance of the acquisition process, with particular emphasis on those necessary for a favorable Milestone I decision. These concepts should address the functional and performance characteristics necessary to meet the mission element need, the necessary interfacing capabilities, and should be accompanied by preliminary life-cycle cost (LCC) estimates and logistic supportability plans. While primarily paper- or study-oriented, technical feasibility models or critical subsystems may be developed during this phase. These are used for examining the feasibility and practicality of the technical state-of-the-art as it relates toward achieving the specified functional program requirements. The various technical areas are examined and evaluated without regard to eventual overall fit or form of the final system. The outputs of this phase should include contractor or laboratory proposals for the efforts in the D&V Phase and the required milestone review documentation (MRD), i.e., System Concept Paper (SCP) and Test and Evaluation Master Plan (TEMP) for major systems; or the Navy Decision Coordinating Paper (NDCP) and/or TEMP for less-than-major programs.

Program Start-Up

The start of the Concept Exploration Phase, or other formal starting point for the program, is a very critical time in the life of the system. Almost immediately after being appointed, the PM is expected to participate in the writing of his "charter", establishing the program office and supporting team, and developing the acquisition strategy which will be the framework for the remainder of the program. The PM's charter and factors affecting the establishment of his organization and acquisition team have been discussed in Section 2, Program Management. Preliminary planning, the acquisition strategy, source solicitation and contracting are discussed briefly in the following paragraphs and then in more detail in Section 4, Critical Topics.

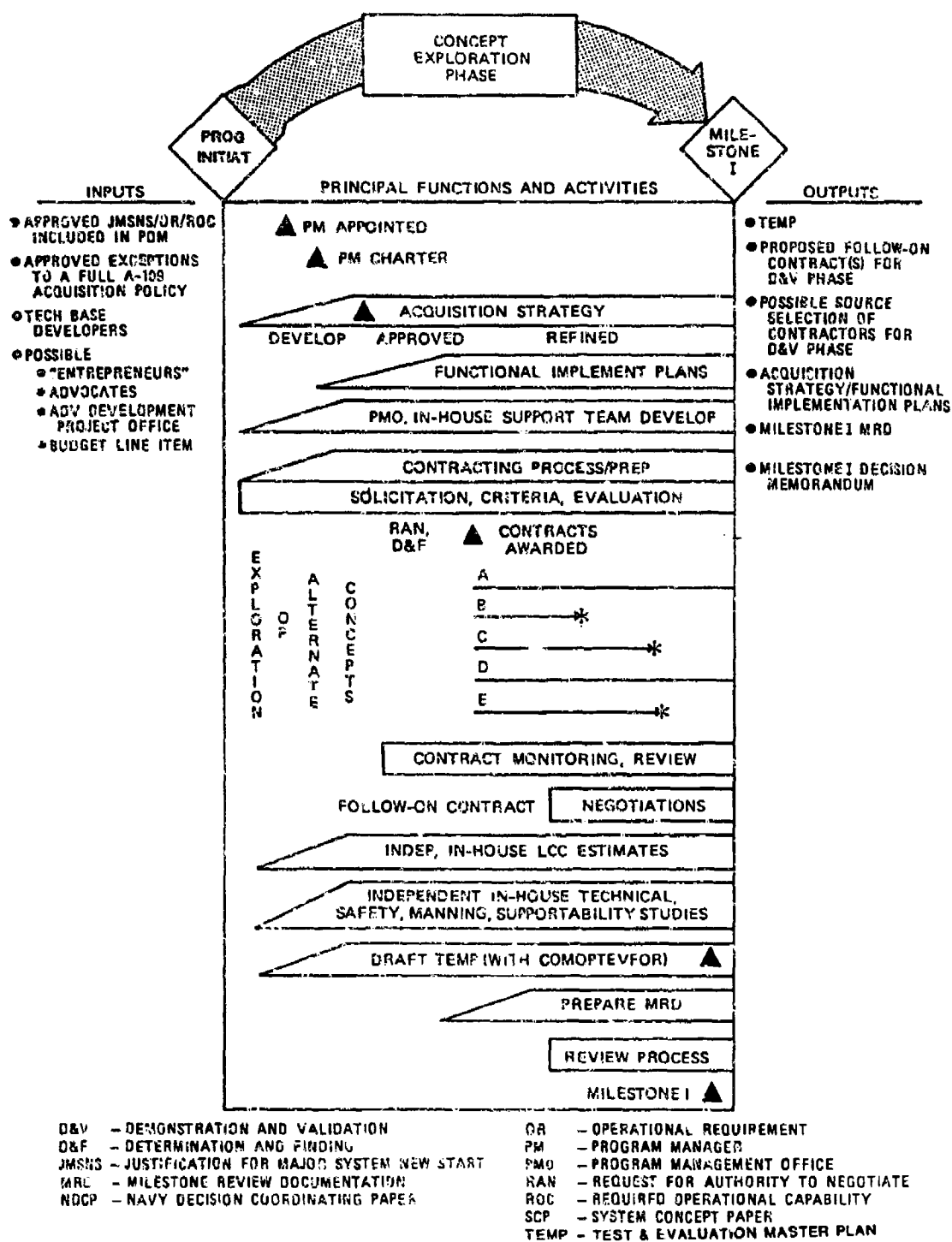


FIGURE 3-5. Inputs, Activities, Outputs during Concept Exploration.

Preliminary Planning. One of the hard-learned lessons of Navy acquisition is that planning must include all phases and related activities from inception to operation support. Problems incurred in a program are inversely proportional to the amount of planning. That does not mean the PM should spend all of his time in planning - just avoid the desire to go to work now and figure out where he is going later. Piecemeal planning results in poor estimates for decision-making purposes and reduces the reliability and credibility of planning estimates. It results in inadequate allocation of resources and in attempted shortcuts that in turn lead to unnecessary time delays, excessive cost, inferior performance, and inadequate logistic supportability. More than any other single factor, careful planning is the hallmark of a successful program. Now is the time for the PM to step back, look at the overall program, and prepare his preliminary plan. The preliminary plan is a foundation for the more detailed planning that will be required of the PM throughout the program.

Among the factors the program manager (PM) should consider in his preliminary planning are:

1. Need
 - o Program criticality or urgency
 - o Scope of mission-area requirements to be met
 - o Background of the need document (an outgrowth of in-house technology development, the result of an unsolicited industrial proposal, etc.)
2. Acquisition strategy (required of Acquisition Category (ACAT) I-III programs with the recommendation that ACAT IV programs follow the guidelines for, and prepare informal strategy)
 - o Level of interest in program to determine possible impacts on acquisition strategy development/approval
 - o Previously documented decisions which may impact acquisition strategy
 - o Degree of newness or technical risk involved; is quick IOC with preplanned product improvement desired?
 - o Impact of proposed program structure (phases and milestones) on acquisition strategy development/approval
 - o How to obtain as much competition (and no more) as desirable; for how long? Recent DOD and Navy policy is to aggressively exploit all opportunities for competitive procurement.
3. Organization
 - o Type of organization needed to manage the program

- o Other events and organizations involved in the acquisition process (see Figure 1-6, Section 1)
 - o Proper balance of logistics, manning, design attributes
4. Preplanning for Full-Scale Development and Production/Deployment Phases.

Consult with Other PMs. In conjunction with his consideration of these factors, the PM should consult with PMs from similar sized programs. No two programs will be alike but there will be similarities and useful insights can be gained. Particularly valuable are the comments of PMs of programs recently introduced into service use. Their lessons learned can help a new PM prevent downstream problems.

Acquisition Strategy. Simultaneously with the establishment of the PMO, the PM must develop and refine the proposed acquisition strategy, which must be submitted within 90 days after program initiation. The acquisition strategy is the key to successful program planning and serves as the skeleton structure on which the functional implementation plans for the remainder of the program will be hung.

The acquisition strategy is one of the vehicles to introduce flexibility into the acquisition system that DOD and Navy directives encourage. The strategy must be tailored to the particular program's needs and, in its preparation, the PM should consider means for shortening the acquisition process; introducing and maintaining competition; streamlining the transition from development to production; and identifying and resolving development, production and operational risks. The acquisition strategy and its development in the Concept Exploration Phase is discussed in greater detail in Section 4, Critical Topics. For those programs that do not require an acquisition strategy paper (ASP) (new ACAT IV programs and revisions to existing programs started before August 1981), an acquisition plan (AP) will be used. The contents of the AP are similar to an ASP but are more detailed and follow the format prescribed in FAR 7.000.

Support Team. The activities of the support team in the Concept Exploration Phase include establishing evaluation methodologies, defining interfaces with other systems, conducting independent cost analyses of the competitive concepts, investigating alternative solutions to program problems, assisting in the collection and dissemination of government-owned information, performing technical reviews, and assisting the source selection team in achieving a full understanding of the proposed concepts.

Source Solicitation and Proposal Evaluation. The PM must be aware of the high-level interest in, benefits of and procedures for competition in the selection of concepts for development. The PM must assume a pro-active role regarding the extent of competition on his program.

The solicitation must describe the mission need in terms of the minimum acceptable performance goals, the anticipated operational environment, MIL-SPECS of required interfaces, and the criteria by which the proposals will be evaluated. Additional discussion on solicitation is provided in Section 4, Critical Topics.

The PM must encourage and give equal consideration to the inputs of industry, Naval laboratories/centers, federal contract research centers, not-for-profit organizations and, if appropriate, foreign sources.

The evaluation criteria should be included in the solicitation as well as the data and data format required for evaluation. Evaluation criteria should be flexible enough to be applied to the most diverse alternative concepts and yet they must be sufficiently structured to permit equitable application to all proposals.

Proposals in response to the request for proposal (RFP) should be evaluated in accordance with the approved source solicitation plan. The responses to the solicitation should identify items, designs or components that the contractors consider proprietary or sole source, and the cost and terms required for the government to use or to acquire them.

Contracting. After the most promising concepts have been selected from the solicitation responses, parallel short-term contracts for further study are awarded. The PM should avoid the urge to reduce his front-end expenditure of time and money since this may lead to a combination of higher costs and lower performance levels in later stages. The contracts issued during the Concept Exploration Phase should provide for easy augmentation to permit the further exploration of promising concepts in greater and greater depth while eliminating less appealing concepts.

Contract Monitoring

Close monitoring of the ongoing contracts by competent technical and managerial personnel is essential. The PM may employ Navy laboratories/centers and/or other Navy field activities during this period to identify potential technical problems and work towards their solution.

Technical Transfusion

The contractors must be treated equally. A technical library containing government-owned information relative to the program, including scenarios, mission analyses, threat information, and the results of government-sponsored research and development, is usually established at the lead laboratory and made accessible to all participants.

The accidental or other technical transfusion from one concept to another, or transfer of information on the status, conclusions and/or findings of one competitor to another, must be tightly controlled. Testimony by the USDR&E to Congress indicates that technical transfusion may take place when it is in the best interest of the U.S. Government.

Such technical transfusion can occur if the government purchases the technical proposals from industry including full data rights. In such a case, the best parts of several proposals may even be combined into one overall concept. Care must be exercised in doing this, and then only with the full concurrence of the bidders. Full information concerning what transfusions will be permitted and how they will be permitted to take place must be provided to the prospective contractors prior to negotiating the original Concept Exploration Phase contracts. It has been the general consensus of industry that there is no need for technical transfusion.

Proposal for the Demonstration and Validation (D&V) Phase

In order to maintain program continuity, each contractor should be required to submit a comprehensive technical and cost proposal for accomplishing the D&V Phase effort.

Negotiations for D&V Phase Contracts

Negotiations for follow-on work should be conducted while the maximum competition exists prior to selection of the most promising candidates for the D&V Phase. Final selection should be made at the conclusion of the Concept Exploration Phase using the previously developed criteria. Funds should be programmed to allow work to proceed on the alternative concepts selected for continuation into the D&V Phase while the formal milestone review documentation is being prepared and the Milestone I review is conducted.

Status Reporting

NMC Selected Acquisition Tracking System (NSATS). NSATS provides information on the qualitative status of selected Navy acquisition programs and assists in the early identification and solution of program problems. All ACAT I and II acquisition programs are required by NAVMATINST 5200.43B to report via the Acquisition Program Status Report, NAVMAT Form 5200/5 (Rev. 11/82), on a quarterly basis. The PM is responsible for preparing the NSATS report. Upon approval by the SYSCOM Commander, the report is forwarded to the CNM. Analysis and dissemination of this information is performed by the NAVMAT Acquisition Divisions.

MILESTONE I

Milestone I Review Documentation (MRD)

The MRD for Milestone I depends upon the acquisition category of the program. The Navy uses the following documentation:

System Concept Paper (SCP). The SCP is used for ACAT I programs to summarize the results of the Concept Exploration Phase and to describe the Navy's acquisition strategy. The SCP will include identification of

concepts to be carried into the D&V Phase and reasons for elimination of other concepts; the extent of competition planned for each subsequent phase; the need for industrial base capacity enhancement and/or manufacturing technology development, as well as critical or unusually long-lead materials; the program structure; and a discussion of how the acquisition process will be tailored to fit the program (including service and SECDEF milestone decision points). The SCP will also establish goals and thresholds to be attained at Milestone II, and will treat any other relevant issues that may have been exposed during concept development. The SCP is not to exceed 12 pages (excluding five annexes). See DODI 5000.2. for required SCP format.

Navy Decision Coordinating Paper (NDCP). The NDCP is required for all ACAT II programs. The NDCP provides the basic review documentation for use in determining the previous phases progress and making recommendations to the SECNAV and/or CNO/CMC for the Milestone I, II, or III decisions. It is limited to three pages, excluding 4 annexes. The NDCP content should supplement and not reproduce information contained in the TEMP. The NDCP should be issue oriented; emphasizing the acquisition strategy, competition and contracting, production planning, anticipated risk areas and means of overcoming them, acquisition logistics, and manpower. See SECNAVINST 5000.1 for required NDCP format.

Test and Evaluation Master Plan (TEMP). The TEMP required for ACAT I programs is defined, in DODD 5000.3, as a summary document of not more than 30 pages. The TEMP is also required by OPNAVINST 3960.10 for all ACAT II, III and IV programs and is limited to twelve pages. It is to be a short, concise master plan for T&E. For ACAT III and IV programs, the TEMP is the single document by which the program is controlled. Its purposes are to identify all required T&E resources; facilitate long-range planning, programming, and budgeting including that of adequate numbers of test hardware items and specialized major range and test facility base (MRTFB) facilities; ensure accomplishment of adequate T&E; eliminate redundant testing; and reduce Fleet RDT&E support requirements to the minimum. The TEMP forms the basic "contract" between the development activity (DA) and COMOPTEVFOR, or the President of the Board of Inspection and Survey (PRESINSURV), or Marine Corps Operational Test and Evaluation Agency (MCOTEA), when appropriate, for conduct of the overall T&E effort. While the initial version of the TEMP, required at Milestone I, will lack many specifics, the iterative revision process will develop the necessary detail. This is further discussed in Section 4, Critical Topics.

Secretary of Defense Decision Memorandum (SDDM). The SDDM documents each SECDEF decision (Joint Service JMSNSs, all ACAT I program Milestones I and II; and, if required, III). The SDDM establishes program goals and thresholds, reaffirms established needs and program objectives, authorizes exceptions to acquisition policy (when appropriate), and provides OSD, JCS, and the DON with direction and guidance for the next phase of acquisition.

Secretary of the Navy Decision Memorandum (SNDM). The SNDM is used to provide the SECNAV's decisions for ACAT IIS programs and include approval of exceptions to the normal acquisition process and other directions. Normally, the SNDM is issued within 15 working days follow-

ing a milestone decision review. A new SNDM is issued to revise goals/thresholds or other program direction when required by threshold breach or PPBS or Congressional action. The SNDM serves the same purpose for ACAT IIS programs as the SDDM serves for ACAT I programs.

Decision Authority Decision Memorandum (DADM). The DADM is used to provide the ACAT IIC and IV PDA'S direction after a milestone review and serves the same purpose as the SDDM and SNDM.

Sponsor Program Review (SPR) Decision Document (SPRDD). The SPRDD, similar in nature to the SDDM and SNDM, is used to provide the OPNAV sponsor's decisions for ACAT III program milestone decisions.

Special Milestone Review Officials and Groups

There are a number of special milestone review groups and individuals who are involved in reviewing and making recommendations during the Milestone I, II, and III decision process. They are as follows:

Defense Acquisition Executive (DAE). The DAE, in accordance with DODD 5000.1, is the principal advisor and staff assistant to the SECDEF for the acquisition of defense systems and equipment. The DAE serves as a permanent member and chairman of the DSARC. In coordination with other DSARC members, he: integrates and unifies the management process, policies and procedures for defense system acquisition; monitors DON compliance with the policies and practices in the OMB Circular A-109, DODD 5000.1, DODI 5000.2 and DODD 5000.3; ensures that the requirements and viewpoints of functional areas are given full consideration during staff and DSARC deliberations, and are integrated into the recommendations sent to the SECDEF; and ensure consistency in applying the policies regarding NATO RSI for all major systems. The USD(R&E) has been designated as the DAE.

Defense Systems Acquisition Review Council (DSARC). The functions and membership of the DSARC are described in DODD 5000.1 and DODI 5000.2. Basically, the DSARC provides advisory support to the SECDEF on acquisition matters. DSARC membership includes

| | |
|----------|---|
| Chairman | Defense Acquisition Executive |
| Members | Under Secretary of Defense, Research and Engineering |
| | Under Secretary of Defense, Policy |
| | Assistant Secretary of Defense, Manpower, Reserve Affairs and Logistics |
| | Assistant Secretary of Defense, Comptroller |
| | Director, Program Analysis and Evaluation |
| | Chairman, Joint Chiefs of Staff or his representative |
| | Service Secretary or his representative |

Navy Acquisition Executive (NAE). According to SECNAVINST 5000.1, the NAE is designated by the SECNAV and has lead authority and responsibility for a specific acquisition program.

The Assistant Secretary of the Navy, Research, Engineering and Systems [ASN(RE&S)] is the NAE for all R&D programs and, with the excep-

tion of ship design and construction, is responsible for the management of R&D programs up to the point where a decision is made to transition to full-scale production.

The Assistant Secretary of the Navy, Shipbuilding and Logistics [ASN(S&L)] is the NAE for all aspects of ship design for ships in the Five-Year Shipbuilding Program and for management and support of all programs after the Milestone III decision is made to transition to full-scale production.

The Assistant Secretary of the Navy, Manpower and Reserve Affairs [ASN(M&RA)] is the NAE for all aspects of manpower and training as affecting the design and development of DON systems.

Competition Advocate General. The Competition Advocate General reports both to the CNM and the ASN(S&L) and is responsible for aggressively fostering competition in the Navy by: reviewing and approving acquisition strategy planning in all Navy acquisition programs; fostering, developing, maintaining, overseeing and directing the Navy Competition Plan; developing, maintaining and overseeing policy and procedures to implement competition in the Navy; providing direct staff assistance to the SECNAV and ASN in the area of competition advocacy in his role as Competitive Acquisition Executive; and fostering and maintaining aggressive interaction dialogue with industry and competitive advocates in other services as well as those at all levels in the Navy.

Department of the Navy Systems Acquisition Review Council (DNSARC). The DNSARC, as defined in SECNAVINST 5000.1, functions as the review body for ACAT IIS programs and ACAT I programs prior to SECDEF/ DSARC review. The DNSARC membership includes

Chairman: Navy Acquisition Executive
Members: Assistant Secretaries of the Navy
Deputy Under Secretary of the Navy, Financial Management
General Counsel
Director, Office of Program Appraisal
Chief of Naval Operations
Commandant of the Marine Corps
Chief of Naval Material

In addition, the Technical Director of the cognizant CNM R&D Center will be called upon to give an independent critique of technological risks associated with the recommended alternative concepts.

Chief of Naval Operations Executive Board (CEB). The CEB's mission, as stated in OPNAVINST 5420.2, is to advise the CNO. The CEB convenes to consider decision alternatives on all major acquisition programs prior to review by the SECNAV and SECDEF. The membership of the CEB is as follows:

Chief of Naval Operations
Vice Chief of Naval Operations
Chief of Naval Material
Director, Navy Program Planning
Commandant of the Marine Corps (Associate Member)

Acquisition Review Committee (ARC). The ARC of the CNO Executive Board (CEB), according to OPNAVINST 5420.2, is to function as a review board for all programs except for ship acquisition and conversion. Its membership consists of:

Chairman: Director, Navy Program Planning
Members: Director, Naval Warfare
Director, Research, Development, Test, and Evaluation
Deputy Chief of Naval Operations (Manpower, Personnel,
and Training)
Deputy Chief of Naval Operations (Logistics)

Ship Characteristics and Improvement Board (SCIB). The tasks of the SCIB of the CEB, in accordance with OPNAVINST 5420.2, include the centralized formulation and coordination of the Navy's shipbuilding and conversion programs, the Fleet Modernization Program (FMP) and ship's characteristics determination for the active and reserve fleets. SCIB membership includes:

Chairman Deputy Chief of Naval Operations (Surface Warfare)
Members Director, Navy Program Planning
Director, Naval Warfare
Deputy Chief of Naval Operations (Submarine Warfare)
Deputy Chief of Naval Operations (Logistics)
Deputy Chief of Naval Operations (Air Warfare)
Commander, Naval Sea Systems Command

Air Characteristics Improvement Board (ACIB). The ACIB has responsibility for all matters pertaining to aircraft and aircraft systems and weapons including: engineering change proposals (ECPs), future requirements; modification; and aircraft and aircraft systems and weapons the PMP process. (NOTE: This description will be expanded when the OPNAVINST covering the ACIB is complete and approved.)

Sponsor's Program Review (SPR). The SPR, as established by OPNAVINST 5000.42, is the forum for making milestone decisions for ACAT III programs. Decision advisors to the OPNAV sponsor include representatives from the following:

Office of Program Planning
Office of Naval Warfare
Office of Research, Development, Test and Evaluation
Deputy Chief of Naval Operations (Logistics)
Commander, Operational Test and Evaluation Force
Chief of Naval Material

Acquisition Review Board (ARB). The CNM, by NAVMATINST 5000.19, and in keeping with OSD policy, disestablished the NAVMAT ARB and has delegated this responsibility to the SYSCOMs. The SYSCOM ARBs serve as the principal forum for acquisition review of ACAT I, II and III programs. The purpose of the ARB is to ensure that the milestone-review presentation accurately reflects the CNM position, that the program itself is logical and executable from a budgetary, business and technological standpoint and complies with applicable tasking from higher authority. The ARB also serves as the forum in which the SYSCOM Comman-

der exercises program decision authority for those ACAT IV programs delegated to him.

Logistics Review Board (LRG). All ACAT I and II programs (with the exception of systems under the responsibility of the Director, Strategic Systems Project Office (SSPC) and the Nuclear Power Directorate, Naval Sea Systems Command) and selected ACAT III and IV programs will be reviewed at key milestones by a CNM-constituted LRG to verify the adequacy of ILS management and implementation.

In addition to the LRG membership listed below, representatives from CMC, ASN(S&L), CNET, CNO(L), DCNO(M,P&T) and DCNO program sponsors are invited, as full members, and encouraged to participate in the logistic review.

Chairman Deputy Chief of Naval Material (Logistics)
Members Vice Commander, Naval Supply Systems Command

Participants in review of cognizant SYSCOM projects:

Deputy Commander, Naval Sea Systems Command Acquisition and Logistics
Assistant Commander, Naval Air Systems Command, Logistics/Fleet Support
Deputy Commander, Naval Electronics Systems Command, Life Cycle Engineering and Platform Integration
Vice Commander, Naval Facilities Engineering Command

Associated Members, participate in all reviews:

Deputy Commander, Naval Supply Systems Command, Fleet Support, Corporate Plans and Logistics
Deputy Chief of Naval Material for Reliability, Maintainability and Quality Assurance
Deputy Chief of Naval Material, Acquisition
Directors of Deputy Chief of Naval Material, Logistics Divisions

Preparation for Milestone I Review

Considerable work and time are required for the Milestone I formal review. As a minimum, the PM can look forward to at least 17 hurdles, as shown in Figure 3-6, before an ACAT I program is reviewed and approved by the SECDEF. This preparation will include updating of the acquisition strategy with emphasis on the next phase. (A list of essential considerations is given in Section 4 under "Acquisition Strategy,".

When it is considered desirable by either the Defense Acquisition Executive (DAE) or the PM, an informal milestone planning meeting (MPM), to identify program issues, may be held before DON submission of the MRD. The meeting can be requested once the PM is sure the program will achieve its phase objectives prior to the proposed DSARC meeting. The MPM is held about 6 months prior to the scheduled DSARC meeting and marks the start of the formal milestone review process. The DOD calen-

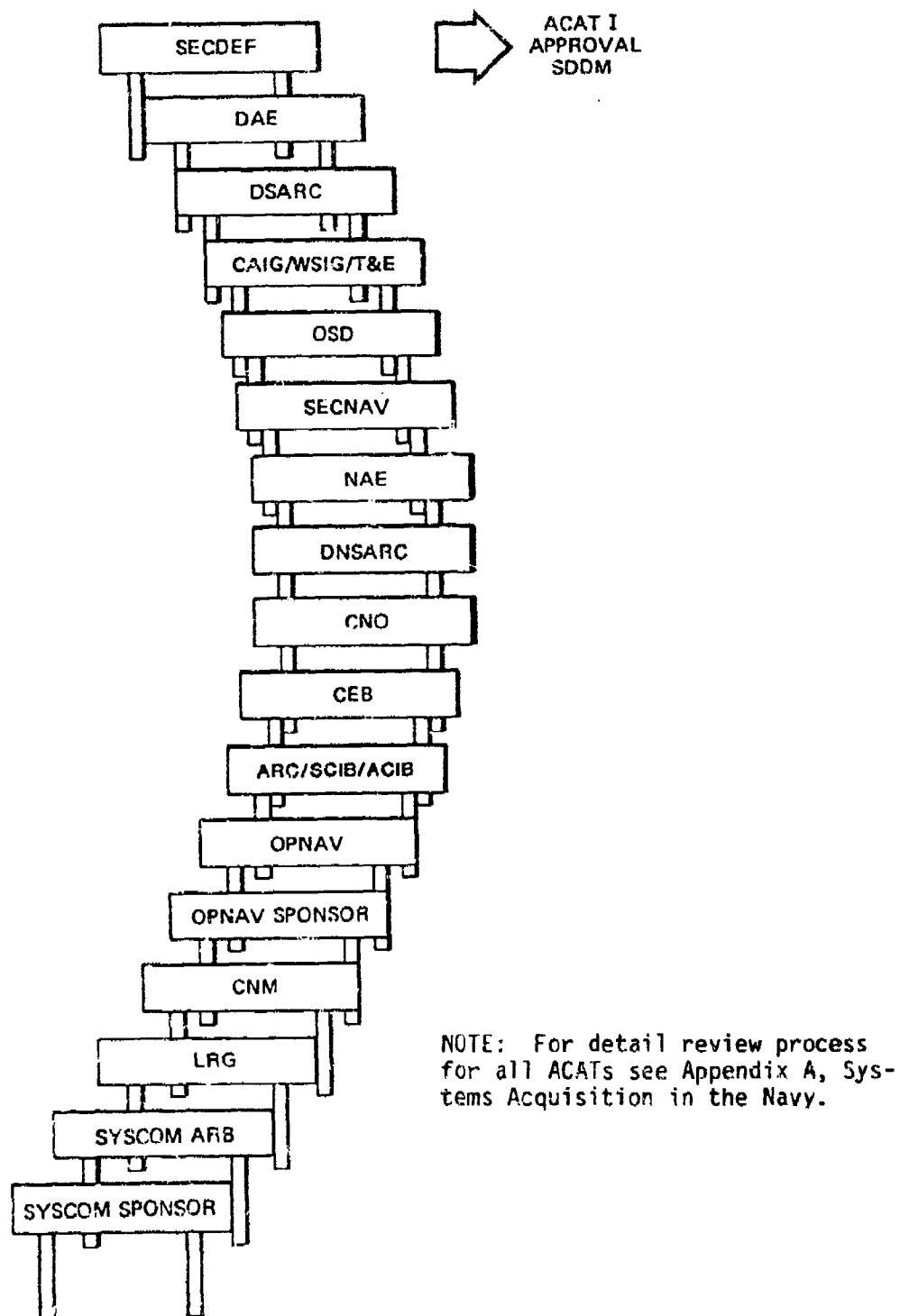


FIGURE 3-6. ACAT I Formal Program Reviews.

dar of events leading to the DSARC is given in DODI 5000.2. Figure 3-7 is a sample schedule of DSARC planning activities for ACAT I programs.

Milestone I Review and Approval

The detailed step-by-step description of the Milestone I review and approval process, i.e., concept selection and approval to enter the D&V Phase - is provided in in Appendix A. The three main steps are:

- (1) the PM prepares the MRD - SCP/NDCP/TEMP - and submits it for review, via the chain of command, to the PDA (SCP/NDCP) and OP-098 (TEMP);
- (2) following review of the MRD, completion of an ILS audit and ILS certification, the PM prepares and presents, via the chain of command, a briefing which concentrates on the issues identified during the documentation review process; and
- (3) the PDA makes his decision and provides his direction - SDDM/SNDM/DADM/SPRDD.

NOTE: The Milestone I review and approval process applies primarily to ACAT I and II programs. ACAT III and IV programs normally do not have a Milestone I review since approval of their program initiation authorizes entry into the D&V Phase.

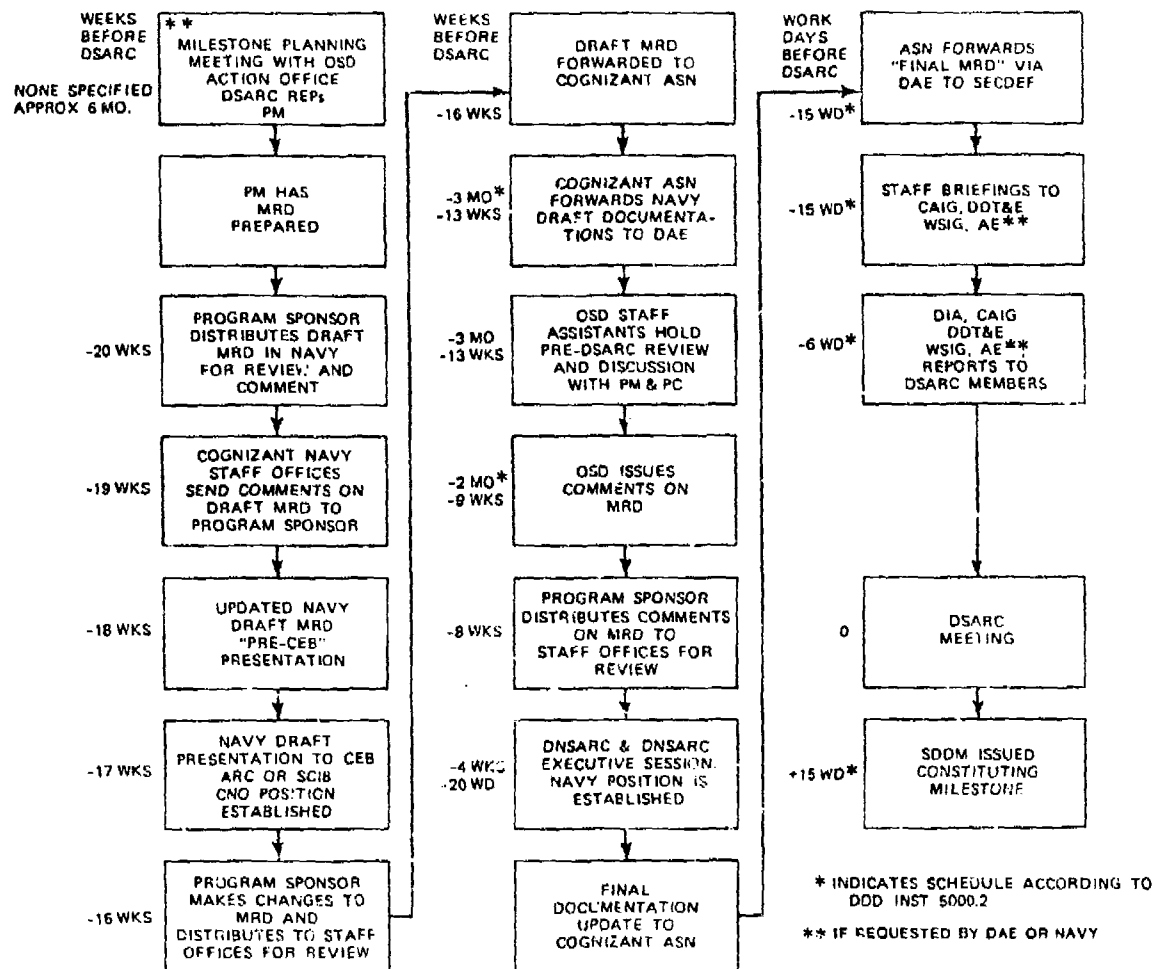
For ACAT IV programs, if a Milestone I review is required, the PM makes his presentation to the SYSCOM ARB and approval to proceed into the D&V Phase is provided by the SYSCOM Commander in a DADM.

For ACAT III programs, if a Milestone I review is required, the PM's briefing is presented to the SYSCOM ARB and the SPR for review and recommendations. The OPNAV sponsor's approval to proceed into the D&V Phase is provided in a SPRDD.

For ACAT IIC programs, the PM's briefing is presented to the ARB, ARC and the ACIB or SCIB as appropriate. Some experienced PMs believe that the pre-ARC meeting is the biggest hurdle of the review cycle and that the PM should really concentrate on this one. After this hurdle, the rest are relatively easy. The ARC/ACIB/SCIB provide their recommendations to the CNO. In turn, the CNO provides his approval to proceed to the D&V Phase in a DADM.

For ACAT IIS programs, the PM's briefing is presented to the ARB, CEB and DNSARC. The DNSARC's recommendations are provided to SECNAV. If the SECNAV is in agreement that an ACAT IIS should proceed into the D&V Phase, his approval is provided in a SNDM.

For ACAT I programs, after basically following the ACAT IIS procedure, the PM's briefing is then presented to the DSARC. The DSARC makes its recommendations to SECDEF who, if in agreement that the program should enter the D&V Phase, documents his approval in a SDDM.



NOTE: THE MRD FOR MILESTONE I IS THE SYSTEM CONCEPT PAPER (SCP).
THE MRD FOR MILESTONE II AND III IS THE DECISION COORDINATING
PAPER (DCP) AND THE INTEGRATED PROGRAM SUMMARY (IPS).

| | |
|--|--|
| AE - ASSISTANT TO SECDEF (ATOMIC ENERGY) | DDT&E - DIRECTOR DEFENSE TEST & EVALUATION |
| ARB - ACQUISITION REVIEW BOARD | DSARC - DEFENSE SYSTEMS ACQUISITION REVIEW COUNCIL |
| ARC - ACQUISITION REVIEW COMMITTEE | MRD - MILESTONE REVIEW DOCUMENTATION |
| ASN - ASSISTANT SECRETARY OF THE NAVY | OSD - OFFICE OF THE SECDEF |
| CAIG - COST ANALYSIS & IMPROVEMENT GROUP | PC - PROGRAM COORDINATOR |
| CEB - CNO EXECUTIVE BOARD | PM - PROGRAM MANAGER |
| CNO - CHIEF OF NAVAL OPERATIONS | SCIB - SHIP CONSTRUCTION & IMPROVEMENT BOARD |
| DAF - DEFENSE ACQUISITION EXECUTIVE | SDDM - SECDEF DECISION MEMORANDUM |
| DIA - DEFENSE INTELLIGENCE AGENCY | WSIG - WEAPON SUPPORT IMPROVEMENT GROUP |
| DNA - DEFENSE NUCLEAR AGENCY | |
| DNSARC - DEPARTMENT OF THE NAVY SYSTEMS ACQUISITION REVIEW COUNCIL | |

FIGURE 3-7. Milestone Planning Schedule for ACAT I Programs.

NOTE: Usually DSARCs, DNSARCs, CEBs, ARCs, ACIBs and SCIBs have "pre-briefs".

All TEMPs are cosigned by the Development Activity (DA) and COMOP-TEVFOR. Approval authority rests with the DA for all ACAT IV TEMPs, with OP-098 for ACAT II and III TEMPs and the SECDEF for all ACAT I TEMPs. The DDT&E must approve Part IV of all TEMPs for programs which require the preparation of Selected Acquisition reports (SARs). Approval of the TEMP by the approval authority constitutes direction to conduct the T&E program contained therein and includes the commitment of Fleet RDT&E support. While the initial version of the TEMP required at Milestone I will lack many specifics, the iterative revision process will develop the necessary detail. The TEMP will be reviewed annually and about two months prior to major decision milestones and will be updated as required to incorporate significant results achieved and changes to plans and milestones. The reasons for changes will be documented.

Significance of Milestone I

Milestone I is the second critical review point in the acquisition process. A favorable decision by the PDA indicates his reaffirmation of the program mission need and objectives, and approval of the PM's selection of system design concepts to continue into the D&V Phase or authorization to proceed with the development of a noncompetitive (single concept) system. This decision is documented in the decision memorandum, which (1) approves program goals, thresholds, and proposed use of P31 plan; (2) authorizes exceptions to normal acquisition policy (when appropriate); and (3) gives direction and guidance for the D&V Phase.

DEMONSTRATION AND VALIDATION (D&V) PHASE

Milestone I marks the beginning of the D&V Phase. In this phase, analyses, hardware fabrication, and T&E will verify that the risks and uncertainties for at least one of the developed concepts are identified and reduced to acceptable levels. The phase will establish that the needed technology is at hand so that only engineering development (rather than exploratory development) is required to bring the concept(s) to fruition. Mission and performance envelopes for the system will be defined, and thorough trade-off analyses of threshold capabilities versus cost will be made so that selection of a concept for Full-Scale Development (FSD) can be made. During the D&V Phase the allocated baseline configuration and other documentation necessary to initiate the FSD Phase are prepared. Figure 3-8 is an overview of the inputs, principal activities, and outputs of this phase. Figure 3-9 summarizes the duties that must be performed in order to meet the objective of the D&V Phase.

The D&V Phase is pivotal in the acquisition process. Dollar expenditures during this phase represent only about 3% of the system LCC. However, since expenditures in the succeeding phases are largely deter-

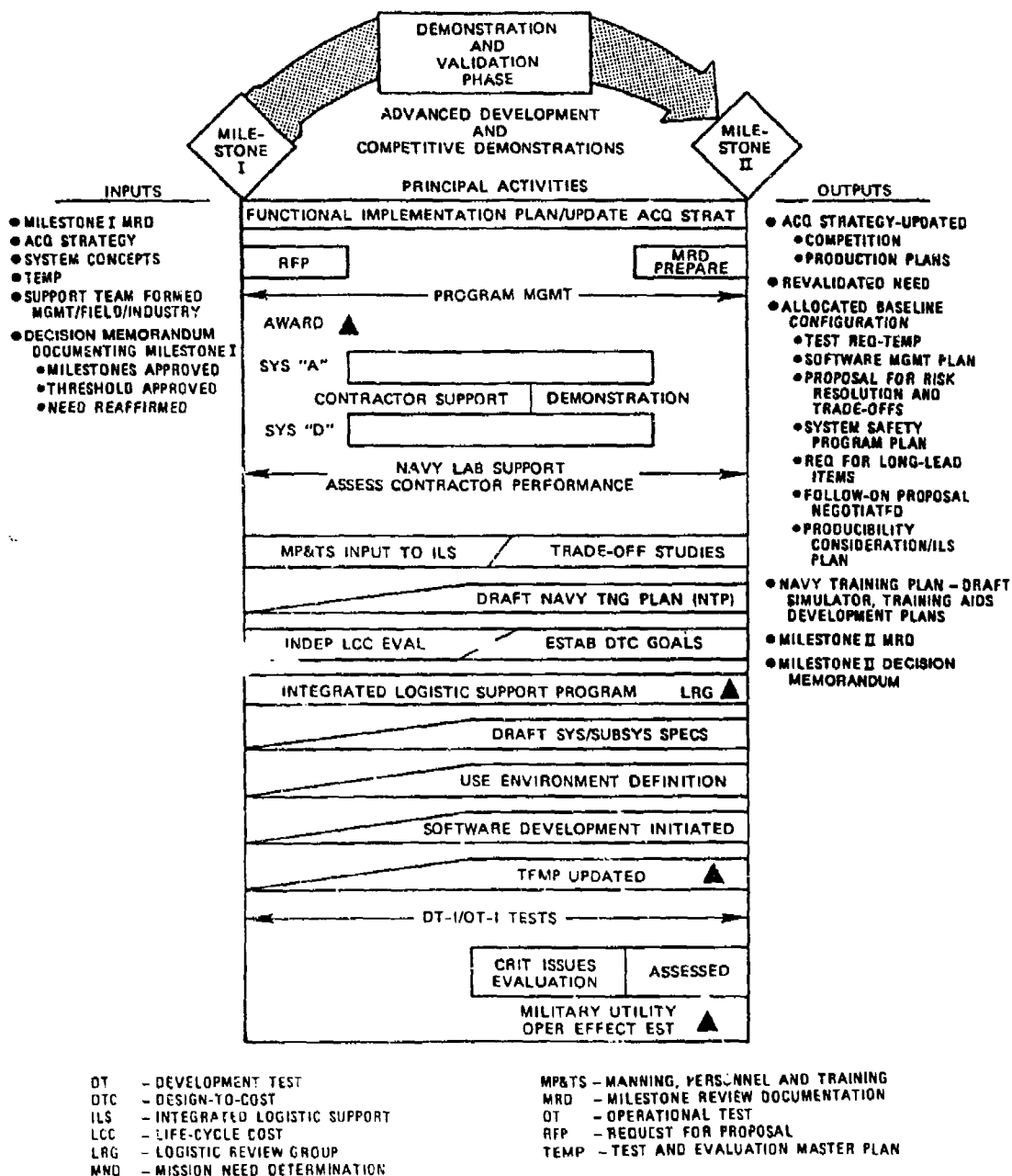


FIGURE 3-8. Inputs, Activities, Outputs during D&V.

- UPDATE ACQUISITION STRATEGY
 - FORMULATE FUNCTIONAL IMPLEMENTATION PLANS
- ADOPT EFFECTIVE TECHNIQUES FOR OFFSETTING THE IMPACT OF UNCERTAINTIES
 - CONSIDER USING THE EVOLUTIONARY INTRODUCTION OF NEW TECHNOLOGY THROUGH PRE-PLANNED PRODUCT IMPROVEMENT (P³I) RATHER THAN DELAYING IOC AWAITING NEW TECHNOLOGY
 - BUDGETING FUNDS FOR TECHNOLOGICAL RISK (E.G. TRACE*)
- COST AND BUDGET MORE ACCURATELY
 - INDEPENDENTLY DEFINE SYSTEM AFFORDABILITY PARAMETERS
 - LIFE CYCLE COST/DESIGN-TO-COST
 - REQUIRE CONTRACTORS TO ESTIMATE MORE ACCURATELY BY UTILIZING:
 - COST REALISM AS A SOURCE SELECTION CRITERION
 - INCENTIVES FOR MEETING COST GOALS
 - INCENTIVES TO MAKE DESIGN-TO-COST (DTC) A VIABLE TOOL
 - PROVIDE ADEQUATE FUNDS FOR TEST HARDWARE TO ENSURE COMPLETE TEST DATA AND TO PROVIDE TEST ARTICLES DEVOTED TO RELIABILITY AND SUPPORTABILITY TESTING
 - BUDGET MORE REALISTICALLY FOR INFLATION.
 - USE BUSINESS BASE PROJECTIONS IN DECISION-MAKING
- CONTRACT FOR COMPETITIVE DEMONSTRATIONS OF CONCEPTS. EACH DEVELOPER MUST:
 - DEMONSTRATE CRITICAL TECHNOLOGY/COMPONENTS/SUBSYSTEMS
 - IDENTIFY TECHNOLOGY AND PRODUCTION RISK AREAS. OUTLINE PROPOSED PROGRAM FOR OVERCOMING RISKS
 - DEFINE CONCEPT SPECIFIC:
 - MAINTAINABILITY/RELIABILITY PLAN
 - LOGISTICS REQUIREMENTS
 - SYSTEM SAFETY REQUIREMENTS
 - LIFE CYCLE COSTS
 - PROPOSED TEST REQUIREMENTS
 - MANNING LEVELS/SKILLS/TRAINING REQUIREMENTS/SIMULATOR DEVELOPMENT
 - SURVIVABILITY/VULNERABILITY REDUCTION TRADEOFFS
 - INITIATE SYSTEM SOFTWARE DEVELOPMENT
 - DEVELOP AND VALIDATE SYSTEM SIMULATION
 - DEVELOP ALLOCATED BASELINE CONFIGURATION SPECIFICATION
 - PREPARE INITIAL SYSTEM DOCUMENTATION (LEVEL 1)
 - PROPOSE RFP/SOW FOR PHASE II, FULL-SCALE DEVELOPMENT INCLUDING TRANSITION TO PRODUCTION
- REVIEW AND SUPPORT OF CONTRACTORS EFFORTS
 - SUPPORT FOR GFE ITEMS
 - TECHNICAL REVIEW OF PROGRESS AND SUBSYSTEMS
 - ESTABLISH TECHNICAL TEAM
 - SUPPORT FACILITIES OF GOVERNMENT RANGES/LABS AS REQUIRED
- UPDATE TEMP (WITH COMOPTEVFOR)
 - FACTORY TO TARGET SEQUENCE
 - ENVIRONMENTAL PROFILE REPORT
- VALIDATE THROUGH DEMONSTRATION:
 - CONCEPT(S) CAN SATISFY MISSION NEED
 - SUFFICIENT INFORMATION TO RESOLVE CRITICAL ISSUES
- CONDUCT TRADEOFF ANALYSIS OF COMPETITIVE SYSTEMS
 - COMPARE TO EXISTING SYSTEMS, THOSE IN DEVELOPMENT ELSEWHERE
- EVALUATE ALTERNATIVES TO A NEW START TO MEET MISSION NEED
- REAFFIRM NEED
- MILESTONE REVIEW DOCUMENTATION (MRD) FOR MILESTONE II
 - PROCESS MRD THROUGH DECISION AUTHORITY REVIEW
- PREPARE FOR FULL-SCALE DEVELOPMENT PHASE
 - CONTRACT NEGOTIATIONS
 - PROGRAMMING AND BUDGETING
 - LONG LEAD-TIME ITEMS/MATERIALS/FACILITIES

*TRACE: TOTAL RISK ASSESSING COST ESTIMATE METHODOLOGIES IS DISCUSSED IN SECTION 3.

FIGURE 3-9. D&V Phase Duties and Outputs.

mined by the decisions made in the D&V Phase, the cost/risk/performance trade-offs made during this phase will have a marked impact on LCC. Therefore, it is generally desirable to maintain design competition at least up to the Milestone II decision point.

Objective of the D&V Phase

At Milestone I, the PDA will have reaffirmed the mission element need and approved the selection of one or more alternative concepts for demonstration. At that point the PM should reexamine and clearly identify the program goals and objectives in the light of the decision memorandum.

The broad objective of the D&V phase is to identify the system concept(s) having the greatest potential for meeting the mission need in a cost-effective manner. This will require the PM to complete a number of tasks that include:

1. Reviewing guidance received from higher authority during and as a result of the Milestone I review process for any change in direction.
2. Ascertaining that the technology base is sufficiently mature to meet the system needs and to warrant proceeding into FSD.
3. Resolving all critical issues that were identified in the Concept Exploration Phase and through the numerous pre-Milestone I reviews.
4. Providing an assessment of each of the selected alternatives evaluated during the D&V Phase for LCC (including logistic supportability), probable mission effectiveness, and risks in sufficient detail to support a selection decision.
5. Completing system and subsystem documentation to the extent necessary to support contracting for the FSD Phase.

Status Reporting during the D&V Phase

In addition to NSATS, discussed earlier, and after the Milestone I thresholds have been established, the PM may be required to submit a Program Management Proposal (PMP).

Program Management Proposal (PMP). The Secretary of the Navy (SECNAV) has established program stability as an essential element in Program Objectives Memorandum (POM) and budget formulation, particularly for the ACAT I and II programs which together account for the majority of Department of the Navy (DON) RDT&E and procurement resources. These and other specified programs are required to submit PMPs twice yearly between the initial POM submittal in the spring and the President's budget in the winter (even if no changes are made in thresholds), and as needed thereafter if the change would affect the DON budget.

- o A change that alters program cost, quantity or schedule
- o A change in system capabilities, such as range, payload, or speed
- o A change that alters Navy support costs, such as manpower requirements or support equipment

A PMP Review Board, chaired by the Director, DON Program Information Center (DONPIC), has been established as a clearinghouse for out-of-cycle PMPs. Current directions for the PMP process are given in DONPIC memo Ser 902/327235 of 23 March 1982 or can be obtained from OP-902

Acquisition Strategy Update

The acquisition strategy should be checked to ensure that it follows the guidance received from higher authority during the Milestone I review and approval and with NAVMATINST 5000.29. Specifically, the PM should see that the acquisition strategy facilitates making and evaluating interrelated decisions before action is initiated. The acquisition strategy should be broadbased and topically parallel to the IPS.

Functional Implementation Plans (FIPs). The PM must prepare and regularly update the FIPs which implement the approved acquisition strategy. Among the FIPs required on most programs are those covering contracting, life-cycle cost (LCC), configuration management, data management, integrated logistic support (ILS), maintenance and support, reliability, safety, test and evaluation, and training.

Organizing D&V Phase Activities

Once the PM has updated the acquisition strategy and reviewed the functional implementation plans, he should review his management system for planning, staffing, budgeting, directing, and monitoring the required tasks. To do this, he should obtain or develop the following:

1. A checklist of phase activities and events. This list will include the activities shown in Figure 3-8 but, being program-specific, will usually be in greater detail.
2. A detailed set of documentation requirements (program and system).
3. An updated file of all directives and instructions that contain requirements for the program and system (see system acquisition instruction and specification tree at the end of Section 4).
4. An updated program organization chart with program members' names, locations, and precisely delineated areas of responsibility. This should be made available to program members and to contractors and other who have business with the program management organization.

5. A survey of the program interfaces with other organizational elements that identifies points of contact and defines the responsibilities of each as they relate to the program.

6. A list and graphical representation of objectives, milestones, and time/task budget projections for the entire phase.

7. A schedule for submitting the required budgetary documents and a calendar of the PPBS process showing the status of program elements supporting the program.

8. A careful identification of the persons and offices above the PM that support and/or influence the program, the type of information they need, and a plan for its timely submission.

Solicitation

Navy acquisition practice permit and encourage the use of a single solicitation for the entire acquisition process, from disclosures of alternative concepts through full-scale development and initial production.

Proposals that included the contractors' cost estimates for the D&V Phase effort should have been required in the solicitation for the concept exploration effort. The items included in the SOW will vary significantly from concept to concept depending both on the proposed system and the nature of the demonstrations and evaluations required to validate the concept. Some areas that should specifically be treated in the D&V Phase are: use environment; cost estimating and data requirements; and system specification and documentation requirements.

The solicitation should contain specific, realistic goals for ILS, safety requirements, reliability and maintainability, manning personnel and training, and other factors that bear on a proposed system's usability and cost.

The solicitation should require that a contractor identify and justify any high-risk technology incorporated in his concept, include specific plans for the reduction of risk, and discuss alternatives to the high-risk approach.

Finally, the solicitation should require that each contractor submit a proposal, including costs, for a Full-Scale Development (FSD) Phase contract prior to the conclusion of the D&V Phase.

Program Manager's (PM's) Effort

The PM must see that there is sufficient, factual information generated during the D&V Phase to permit an intelligent selection of the best of the competing concepts. He must develop (independently, but with appropriate contractor inputs) the TEMP, the ILS Plan (ILSP), the Navy Training Plan (NTP), plans for manpower, personnel and training support (MP&TS), independent program plan, mission profile definition,

and system software definition. The PM must also oversee the demonstration program and conduct trade-off analyses of the competitive systems (these subjects are discussed in more detail in Section 4, Critical Topics). The PM may also find it necessary to initiate parallel or back-up in-house Navy technology efforts to determine alternative means for dealing with identified high-risk areas and develop system software. A large part of the PM's time and effort will be spent in active liaison with NAVMAT, OPNAV, SECNAV and OSD, informing them of the program's progress and possible problems, and justifying the program funding and objectives.

Planning for the Full-Scale Development (FSD) Phase

Issues that the PM and his team will want to consider in updating the acquisition strategy and planning for the FSD Phase include:

1. Level of contractor tasking during government-decision periods
2. Support and facilities (both government and industry) that will be needed in the FSD and Production Phases
3. Possible changes of the threat and revalidation of the need
4. Proposed system performance, readiness time, and cost thresholds
5. High-risk technology or new manufacturing procedures that may require extra attention during the FSD Phase
6. Identification of potential long lead-time items
7. Analysis of subsystems and components for possible breakout for competitive procurement or provision as government-furnished material (equipment) (GFM/GFE)
8. Type of contracts for FSD Phase and first volume production
9. Costs to be incurred if competition reinstated for production.
10. Degree of concurrency for engineering, prototype, and pilot-production subphases and the extra attention necessary to manage concurrency
11. Task planning and development of the Work Breakdown Structure (WBS) and associated costing and cost control/reporting
12. T&E continuation
13. Preplan for transition to production (pilot production)
14. Preplan for Production and Deployment Phase.

Monitoring

The process of assessing technical accomplishment, identifying alternatives, and making the requisite decisions can, at times, be rather subjective, reflecting "engineering judgment". To minimize any possible adverse effects of such judgments, it is important to have an independent assessment of the accomplishment and its consequences by technically competent personnel. This needs to be done whether the accomplishment is the result of in-house or contractor effort; however, it is especially critical for contractor-performed effort since contractor incentives are generally different than government incentives, and the contractor's understanding of government requirements and priorities may be imperfect. Normally, the Defense Contract Administration Service (DCAS), Navy Plant Representative Office (NAVPRO) or Air Force Plant Representative Office (AFPRO) are not staffed for this function to the depth required (both in numbers and in specialized technical knowledge), monitoring capability is most often found in the Navy in-house R&D laboratories/centers. If such an assignment is to be made, it needs to be made prior to the start of any contract effort. Responsibility and authority, assignments, delegations and the precise nature of the monitoring task need to be defined carefully and formally and explicitly established that the authority delegated to the technical monitoring activity must be explicitly stated and commensurate with the responsibility assigned, if that activity is to be held accountable for the discharge of that responsibility.

Two negative features are associated with the assignment of the monitoring function. First, it generally increases costs. This should be recognized and provided for. Second, in-house talent may try to assume control of the engineering effort. The best engineering judgments sometimes differ, and the PM may sometimes have to overrule the in-house monitor. Overall, though, the PM and his program are better off for this monitoring function than if it were not used.

MILESTONE II

The second major decision is program go-ahead and approval to proceed with FSD. The timing of the Milestone II decision is flexible and depends upon the tailored acquisition strategy approved by the PDA at Milestone I. NOTE: The delayed Milestone II option of DODD 5000.1 will normally not be used for DON-directed programs.

Milestone II Review Documentation (MRD)

The MRD for Milestone II is the same as for Milestone I (see page 3-18) except for ACAT I programs. Instead of the SCP, ACAT I programs require a Decision Coordinating Paper (DCP) and a TEMP. In certain cases the DAE may also require, for an ACAT I program, the preparation of an Integrated Program Summary (IPS) when he feels that the information contained in the DCP requires expansion. ACAT II programs require the submission of an NDCP and TEMP and ACAT III and IV programs require the submission of a TEMP. The NDCP and TEMP were described previously in the discussion of documentation needed for Milestone I review.

Decision Coordinating Paper (DCP). The DCP is a top-level, issue-oriented summary document that identifies alternatives, goals and thresholds, and cost. The DCP summarizes the Navy's acquisition planning for the system's life-cycle and provides a management overview of the program. It is limited to 18 pages, excluding annexes. See DODI 5000.2 for the required DCP format.

Integrated Program Summary (IPS). The IPS does not repeat information contained in the DCP but provides more specific information and a comprehensive summary of the program. When further detail is available in published documents, those documents are referenced in the IPS. When possible, display material is in numerical or tabular form. The IPS should not be classified higher than Secret. The DCP and IPS, if required, provide different levels of detail for consideration by the DSARC at Milestone II and Milestone III. It is limited to 30 pages including all attachments. See DODI 5000.2 for the required IPS format.

Milestone II Review and Approval

The review and approval process for Milestone II is basically the same as for the Milestone I, as described earlier and in Appendix A.

Significance of Milestone II

Approval by the PDA reaffirms the Navy's commitment to fund the expensive FSD Phase. The FSD Phase usually includes a pilot production subphase where the production line is established, using RDT&E funds, to produce test articles for TECHEVAL and OPEVAL. Except for long lead time items (which can be approved at the PDA program review), production funds (APN, OPN, SCN) can not be used to buy articles until a Milestone III ALP/AFP is approved. Approval at Milestone II is also a commitment by DON to produce and field the system. Included in the approval is the selection of the system design and the establishment of firm schedule, cost, and capability thresholds.

Ship Acquisition. Ship development and acquisition will follow a procedure tailored to the individual design. In typical ship acquisition programs, Milestone II will authorize lead-ship construction and Milestone III will authorize follow-ship construction as shown in Figure 1-5 in Section 1.

Program Stability. Private and public figures are concerned with the cost growth associated with weapon acquisitions. Congressional scrutiny becomes particularly acute not only at the time of initial and ongoing annual appropriations, but also when a new weapon system experiences slow development, cost overruns, delays in fielding, or questionable performance. The scrutiny is even more intense when these problems are attributable, at least in part, to unrealistic inflation estimates, poor cost estimates, program stretch-outs, changes in weapon systems specifications, inadequate budgeting, lack of competition, high risk system design, or poor management.

The schedule, cost and performance thresholds established at Milestone II are to be kept. Upward deviation from these established thresholds may jeopardize the continuance of the program. While all PMs are required to keep their programs on schedule, the ACAT I and II programs come under special attention because of their very large LCC. In short, "If you want to get your boss' attention, break threshold."

FULL-SCALE DEVELOPMENT (FSD) PHASE

Milestone II marks the beginning of the FSD Phase - a period of careful, iterative, detailed, and therefore expensive, engineering effort. The final product of this phase is a product baseline configuration design and a documentation package that reflect the established cost, schedule, logistic supportability, and performance constraints. The phase is usually conducted in three partially overlapping subphases: engineering, prototype, and pilot production. Figure 3-10 is an overview of the inputs, principal activities, and outputs of the FSD Phase.

The various subphases of the FSD Phase referred to here are characteristics of good engineering practice. They are not part of the official lexicon of the systems acquisition process as defined in DODD 5000.1. Under the existing system, difficulty is often encountered in making the transition from development to production. One reason is that DODD 5000.1 treats the transition as a step function occurring at Milestone III, rather than as a ramp function. As a result, comptrollers are reluctant to allow the use of production money for the development of hard tooling and production facilities prior to the official Milestone III go-ahead.

Proposals have been made to establish an interim milestone, prior to the start of the pilot-production subphase, for the purpose of freeing production dollars. This could be done provided that the interim milestone is called for in the acquisition strategy and significant portions of the design have matured, the product baseline has been documented, and contractor planning for production (including reliability, quality assurance, etc.) is ready for implementation. A formal review and approval by the appropriate PDA would be necessary at this time to commence limited or pilot production. The purpose of this proposed additional milestone is to facilitate the transition to production; extra planning and care by the PM would be necessary to prevent disruption of the program while preparing for the review.

Objectives of the FSD Phase

The objective of the FSD Phase is the demonstration and documentation of a cost-effective, operationally suitable, reliable, and maintainable production-engineered system that meets the mission need. At the outset of the phase, the PM should re-examine the specific program objectives to ensure that they reflect the guidance set forth in the Milestone II SDDM/SNDM/SPRDD/DADM.

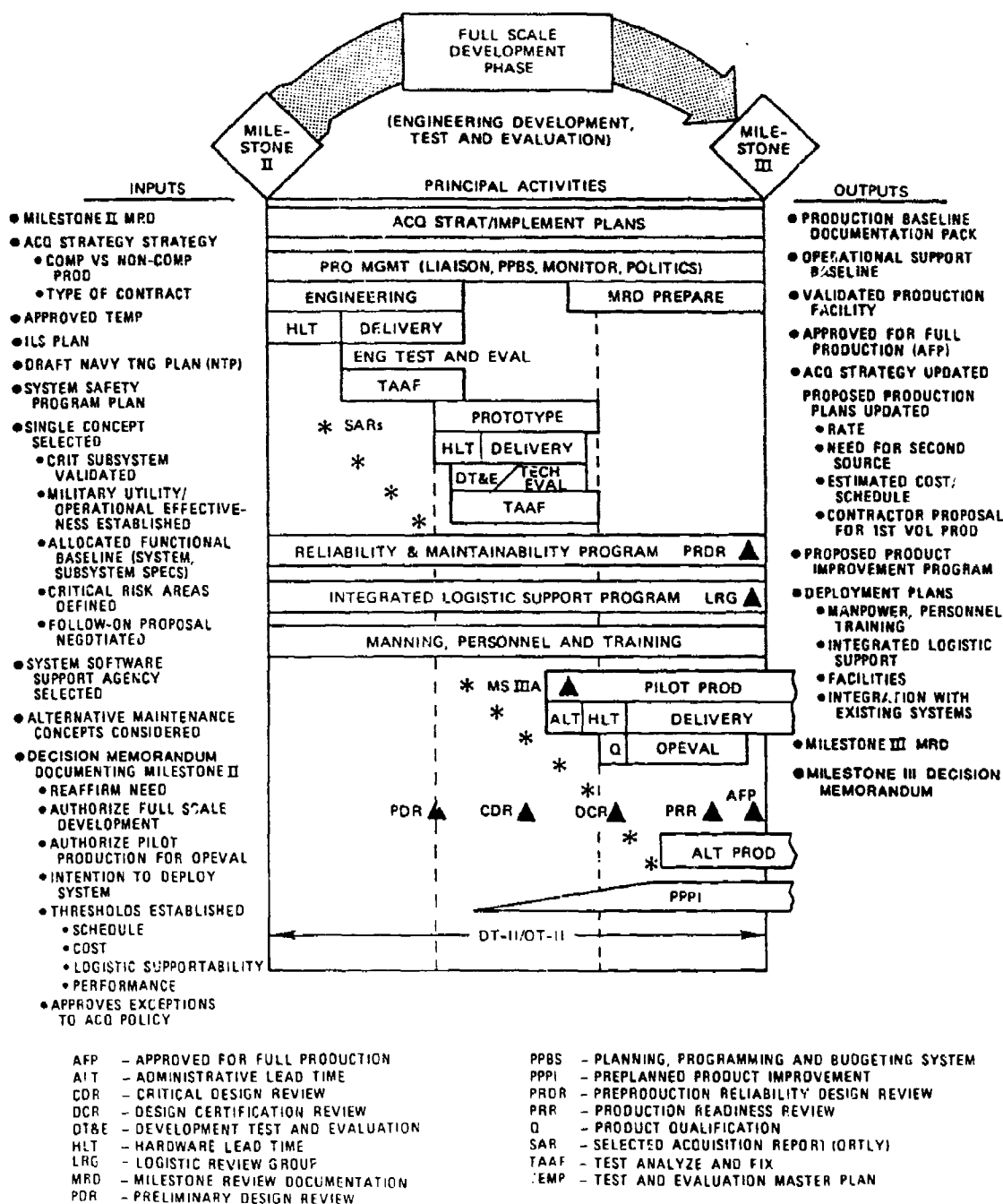


FIGURE 3-10. Inputs, Activities, Outputs during FSD.

Status Reporting during the FSD Phase

In addition to NSATS and PMP reporting, discussed earlier, the PM may also be required, after Milestone II, to prepare additional reports, as follows:

Selected Acquisition Reports (SARs), the Nunn Amendment and the Defense Acquisition Executive Summary (DAES). SARs are quarterly reports to Congress that summarize the status and cost of ACAT I programs that have reached Milestone II. The SAR system allows routine visibility of major defense acquisition programs and cost trends that were not previously available to Congress. Additional unit cost reports are required by Congress (originally as part of the DOD Authorization Act of 1982 - the "Nunn Amendment"). This requires that if the total program acquisition unit cost or the current procurement unit cost of a weapon system exceeds by 15% the March 1981 SAR estimate (So-called "Nunn Busters"), then a report on that system must be submitted to Congress as well. Also when program unit cost or the current procurement unit cost of a weapon system exceed the March 1981 SAR estimate by 25%, SECDEF is required to make certifications concerning that program to Congress. If this is not done, authority to obligate funds for that program is automatically terminated. DOD has institutionalized this in DODI 7220.31 and now requires a periodic unit cost report, the DAES, on all ACAT Is.

Acquisition Strategy Update

The PM should conduct a comprehensive review of the acquisition strategy and FIPs in conjunction with a review of the Milestone II decision document. The acquisition strategy and FIPs should be adjusted to accommodate any specific instructions from the decision authority. A review of the program management system is also in order at this time.

Although not a requirement, it is a good idea for the PM to give his entire management/support team an in-depth briefing on the strategy to be employed in the FSD Phase. The briefing should include a review of the management tools available and their status and include a discussion of the following items: Work Breakdown Structure (WBS), LCC, management review and checking procedure, risk management, competition in production, component breakout and design ownership.

Organizing the FSD Phase Activities

Concurrently with the review of the acquisition strategy, the PM should prepare a checklist of phase activities. This will help him to assess the program's readiness for the commitment of the large quantity of RDT&E dollars required for the FSD effort. The checklist will vary significantly from program to program but should address the considerations enumerated below.

1. System Specification. Review the system specification for incorporation of guidance from higher authority and the elimination of unnecessary constraints. Determine its completeness and suitability as the governing performance requirement document for the FSD Phase effort.

2. Development Specifications. Review, for correctness and clarity, the development specifications that govern the individually identified configuration items.

3. Test and Evaluation (T&E). Expand the details of the development test and evaluation (DT&E) program including determination of the data requirements, particularly the required degree of accuracy. It should be remembered that test data, without a documentation package describing the design tested, are worthless, and the hardware/software must be built to applicable approved documentation if test programs are to have any meaning. Note that the PM must establish early and continuing liaison with the Operational Test and Evaluation Force (OPTEVFOR) to ensure that operational test and evaluation (OT&E) requirements are identified and integrated into the program with proper support budgeting. The PM must provide COMOPTEVFOR with all significant DT&E test data and analyses that will assist in planning or interpreting OT&E. OPTEVFOR is required to monitor all pertinent phases of DT&E.

4. Integrated Logistic Support (ILS). Intensify the ILS planning effort to ensure suitable, aggressive input to the design evolution process and resultant supportability.

5. Design Documentation. Arrange for in-process reviews of design documentation including a detailed review of the contractor's configuration control process. Assign responsibility for instituting the corrective action required to ensure compliance with the documentation requirements. The corrective action is probably best done by an agency other than the developing contractor.

6. Personnel Training, Simulators and Training Devices. Plan for the attainment and maintenance of the required proficiency for operating and support personnel, and determine the scope and duration of on-the-job, simulator, and formal training requirements. Identify anticipated savings from use of simulator or other training devices. The development of simulators and training devices must proceed on a schedule that will make them available to train Fleet personnel for OPEVAL and IOC.

7. Other Considerations. Ensure that the Phase II plans address:

- o How to maintain program stability and continuity while awaiting results of TECHEVAL, OPEVAL, and program reviews.
- o The use of foreign products and/or parts and material.
- o Planning for the procurement of long lead-time hardware items and tools, the stockpiling of critical material, and the acquisition or preparation of special manufacturing and storage facilities.
- o Competitive second-source procurement potential.
- o The effects of possible variations in production rates on unit cost and how these can be kept within acceptable thresholds.

Engineering Subphase

The engineering subphase features a design-build-test-redesign iteration of engineering development models (EDM) to evolve component, equipment, subsystem, and system designs that meet the requirements of the allocated baseline configuration. The EDMs, developed during a program's FSD Phase, are "flyable" and will be extensively tested to ensure that functional and technical objectives can be achieved. The models are used to demonstrate that tactical performance capability of the system under typical operational conditions, as well as to establish the hardware design baseline.

In this subphase, system attributes such as reliability, maintainability, safety, supportability, etc., are established by the design. It is very important that the PM have these characteristics established and their adequacy verified during this subphase since downstream changes will be very expensive. When completed, this subphase will have defined and documented a product design disclosure which can be used in the fabrication of the first prototype models of the following subphase. Listed below are matters that the PM must be aware of, plan for, and carefully oversee. He should develop his own specific actions to address each item.

- o Fabricate engineering development models
- o Expand the WBS to required levels
- o Refine subsystem development specifications
- o Develop preliminary support equipment design
- o Update ILS requirements
- o Update functional implementation plans
- o Update cost goals
- o Update system simulation
- o Develop document control plan
- o Implement test and evaluation plan
- o Perform reliability and maintainability analyses
- o Confirm that the design meets human engineering goals
- o Verify external interfaces
- o Confirm survivability enhancement features
- o Confirm susceptibility reduction features
- o Confirm reliability and maintainability features
- o Detail the prototype design
- o Prepare level-2 documentation
- o Implement uniform closed-loop failure reporting analysis and corrective action system
- o Prepare preliminary producibility assessment
- o Conduct preliminary design review.

Prototype Subphase

In the prototype subphase, the system evolved during the preceding engineering subphase will be further refined. The subphase features a build-test-modify/redesign-build-test iteration. From this iteration, a design disclosure will develop that describes a physical and functional equivalent of the product expected to be produced for service use. The final units delivered under this program together with the results of

the iterative process will provide the test items required for TECHEVAL. Final decisions affecting the design are based upon the results of the TECHEVAL. The documentation package released to pilot production must include all critical process specifications, inspection procedures, and all other instructions necessary for successful manufacture of the pilot production models. Listed below are activities that the PM should be aware of and provide for:

- o Fabricate the proper number prototype models
- o Integrate system software
- o Complete design and fabrication of support equipment models
- o Conduct test and evaluation
 - o Test, analyze, and fix (TAAF)
 - o TECHEVAL
 - o Conduct system qualifications program: environmental, safety, vulnerability, initial reliability, and nonstandard parts
- o Complete production facility
- o Update cost goals
- o Develop support facilities
- o Complete logistic plans
 - o Training (final and for OPEVAL)
- o Complete technical data compilation
- o Develop production design
- o Provide level-2 or -3 documentation
- o Develop product baseline configuration specification
- o Conduct production readiness review
- o Update system simulation
- o Provide initial support equipment
 - o Design
 - o Long-lead procurement
- o Conduct critical design review (CDR) as basis for release to pilot production

Among the critical issues to be address during the prototype sub-phases are:

1. Quality Assurance (QA). QA provisions must be spelled out if their efficiency is to be verified in the pilot-production subphase. These include any requirements for special incoming or in-process inspections or any specific data requirements or test necessary to ensure the quality of the end product. However, as indicated in Section 4, "Quality," specific data and tests, per se, cannot assure the quality of a product - these must be designed in.

2. Rework Philosophy. Repair procedures for any faulty, in-process equipment and any unique Material Review Board (MRB) requirements should be defined in the prototype subphase so that they can be verified in the pilot-production subphase.

3. Configuration Management. Configuration control and the approval procedures for baseline configuration design changes should be fully evolved by the start of the prototype subphase. While configuration control should not be so cumbersome as to hinder progress, it should be elevated to program-management-office level at the start of TECHEVAL.

4. Reliability and Maintainability. Design attributes affecting the systems reliability and maintainability should have been incorporated in the basic system design before and during this subphase. A good system for closed-loop-failure reporting, analysis, and corrective action should also have been established.

Pilot-Production Subphase; the Transition to Production

The purpose of the pilot-production subphase is to exercise the system hardware and software design disclosures, and the data package evolved during the prototype subphase, in the production environment. During this subphase the system, using R&D funds, will be made with production hard tooling, using production processes and procedures, and inspected with production test equipment in accordance with applicable instructions. Documentation of test and inspections procedures must be adequate to control quality at the vendor's plant.

The hardware and software items that are produced during the initial stage of this subphase are evaluated to determine the existence of degradation resulting from the production processes and procedures and to provide a basis for correction. Successive systems will provide the test articles required for the formal OPEVAL conducted by the independent test agency (OPTEVFOR or MCOTEA). A successful OPEVAL is required for CNO approval for full production (AFP) and support of the major production decision (Milestone III). Any remaining systems can be used to help provide the IOC.

Continuity of the production effort should be considered at this time. Beginning with the prototype program, the contractor should establish a production capability by training key personnel in the special processes and procedures that are unique to the manufacture of the item. As the knowledge and capability of these people increase, the quality of the product also increases. If this quality is to be retained, it is essential that the key employees be involved in the production effort on a continuing basis lest they be transferred to other projects. This threat to product quality through reduction in expertise may be prevented by arranging for the pilot-production line to continue to produce at a minimum sustaining rate until the initial volume production effort. If pilot production were halted when the articles needed for contractor qualification and OPEVAL were delivered, some portions of the production line would be idle for a considerable period. Keeping the same key people on the job and busy by extending the pilot production run ensures that the hardware delivered for service use under the initial volume production contract will be on the same learning curve and, hence, of at least as good a quality as that delivered under the pilot-production program. This option is available to ACAT I and II programs by the use of the Milestone II/IA ALP structure.

Continuation of pilot production has an additional advantage in that it can lead to an earlier IOC than would otherwise be possible. However, the achievement of an earlier IOC is rarely an adequate justification for continuation of the pilot line beyond the requirement for T&E hardware, and PDAs will generally not accept it as such. Unless there is overwhelming need and urgency, sole justification for continua-

tion of the pilot line rests on the necessity for continuity in the production effort and the maintenance of a steady, uninterrupted increase in the quality of the article being delivered.

An issue that must be resolved prior to the start of the pilot-production subphase (if a Milestone IIIA review has not been held) is the location and staffing of the pilot facility. Large contractors sometimes develop a design in one division and produce the product in another division located in a different geographical area. It should be required that the pilot line be established at the full-scale production facility and that it be staffed by personnel with the same qualifications and job classifications as those who will staff the full-scale production line.

Whenever production is transferred from one division of a company to another, those divisions react to the design as would a new manufacturer of the product - the equivalent of "going back to square one". If it becomes necessary to effect such a transfer, the government should require that a preproduction model be produced by the new division and be qualified before that division is allowed to produce for the service-use inventory.

Below is a list of important activities which should be provided for during the pilot-production subphase. The updated functional implementation plans should contain a more detailed cleanup list of all development actions, tests, documentation, etc., that remain to be completed during the FSD Phase.

- o Fabricate pilot-production models
- o Conduct T&E
 - o Production qualification tests
 - o Reliability and maintainability demonstration
 - o OPEVAL
- o Validate producibility
- o Conduct first article configuration inspection (FACI)
- o Validate manufacturing screening procedures
- o Validate acceptance criteria
- o Provide hardware for OPEVAL
- o Validate Navy training procedures
- o Validate manuals
- o Obtain approval for full production
- o Update production design
- o Provide validated full-scale production documentation
- o Conduct Production Readiness Review
- o Conduct preproduction reliability design review (PKDR)
- o Initiate P³I program (if applicable)
- o Commence planning of successive phases of P³I or product improvement program (PIP)

Approval for Full Production (AFP)/Approval for Limited Production (ALP)

The Navy's policy of requiring an approval for service use (ASU) or one of its related lesser designations (provisional approval for service

use or waiver in advance of ASU) has been eliminated in order to streamline the acquisition process. The new procedure is less duplicative and less susceptible to misinterpretation and misuse. The purpose of the new procedure is to maintain rigorous control of the production decision and thus ensure that equipment introduced to the Fleet is effective, reliable, maintainable, and supportable.

At Milestone III, the appropriate PDA will make one of three production decisions after reviewing appropriate development, reliability, test, and evaluation data. The three alternative decisions are:

1. AFP
2. ALP - a 1-year limited quantity approval
3. Not approved for production

Detailed instructions for processing the AFP/ALP can be found in OPNAVINST 5000.42 and NAVMATINST 5000.19.

AFP signifies that the system has demonstrated, through TECHEVAL, the meeting of its technical thresholds; that it has demonstrated, through OPEVAL, both the meeting of operational thresholds and its operational effectiveness and operational suitability; and that it has shown, through ILS audit, that support planning is satisfactory. No additional development work or corrective action is required.

ALP signifies that the system -- although not yet having demonstrated all the capabilities required for AFP -- has undergone initial phases of DT&E, OT&E and personnel/logistic review to the extent that most of the AFP criteria have been demonstrated; COMPTTEVFOR has assessed the system as being potentially operationally effective and operationally suitable; and a clear plan and funding exists for completion of development or corrective action, demonstration of meeting remaining thresholds and being logistically certified prior to the next year's production decision point.

The Navy exercises rigorous, high-level control of the production approval process to ensure that all equipment reaching the fleet -- even that from the earliest production lots -- meets the intended standards of performance, reliability, maintainability and logistic supportability. This can only be accomplished by paying closest attention to actual DT&E and OT&E results and support planning, at each Milestone III.

Ideally, the objective of the Navy acquisition process would be to have all systems complete development and demonstrate meeting all technical and operational thresholds through full TECHEVAL and OPEVAL, and demonstrate all ILS requirements, prior to production line startup, which would be accomplished with an AFP decision.

This objective can be met in smaller programs (ACAT IV and most of the ACAT IIIs); however, the extensive production line effort required in large programs (ACAT I, most of ACAT II and a few ACAT III) require "transition to production" phasing using ALP for the initial production

lot (or possibly two lots in the case of extremely large ACAT I programs).

In each case where an ALP decision is required, every effort should be made to complete development work or corrective action and demonstrate the meeting of all thresholds through DT&E and OT&E prior to the next year's AFP/ALP decision point. If there is doubt at Milestone IIIA, startup of production should be delayed rather than risk several years' production under ALP.

Similarly, any ALP decision should cause the decision-maker to give strong consideration to reprogramming RDT&E funds into the program and inserting additional DT&E and OT&E phases prior to the next year's production decision point. Detailed initial attention to program structure and adequate RDT&E funding should ensure that no more than one year's production is carried out under ALP status.

Advanced Preparation for the Production Phase

In addition to the normal review and checks, some area may require special attention to ensure a smooth transition to production and deployment. The PM should review the system's production plan, concentrating on those portions appropriate to the Production and Deployment Phase (see DODD 5000.34). He should give special attention to areas of production risk, establish requirements for parts control, initiate long lead-time procurements, carefully review the production documentation package, and initiate such other actions as may be necessary to facilitate transition to initial volume production for service use.

The PM should also review the manpower requirements for operation and maintenance of the system, and any changes in the estimates of the number and level of training should be discussed during the Milestone III review. During the milestone review, the PM will provide a summary (by fiscal year and occupational specialty) of all formal training requirements for all personnel required to man the proposed system, and identify numbers of personnel trained and training cost (including the cost of facility modifications). He should separately identify the net impact on special-emphasis training program such as undergraduate flight training.

During the milestone review, the PM should summarize plans for attaining and maintaining the required proficiency of operating and support personnel, and quantifying the scope and duration of their on-the-job, simulator, and formal training requirements. He should identify anticipated savings from the use of simulator or other training device.

Finally, the PM should review the facilities that the Navy will use to support the system and verify that any new facilities required by government or industry are adequate and will be available when needed.

Planning for the Production and Deployment Phase

In preparation for Milestone III and the Production and Deployment

Phase, the PM should ensure that all the documentation required for the review is complete and the program is ready for this review. The list below contains major requirements for the Milestone III decision to enter into full-scale production and deployment.

1. The mission need is reaffirmed in the light of an updated threat.
2. Development has progressed satisfactorily and the DT&E/OT&E results support a decision to proceed with production and deployment.
3. The acquisition strategy has been updated and is being executed.
4. Business planning supports the acquisition strategy and provides flexibility for production rates and quantities when options are used.
5. Schedule and cost estimates remain realistic and acceptable, including support and operating costs.
6. Design-to-cost requirements and LCC estimates are still realistic and will permit achievement of LCC objectives.
7. The system continues to be cost-effective and affordable and remains the best alternative to meet the mission need.
8. Trade-offs have been made to effectively balance cost, schedule, performance, and logistic supportability requirements.
9. Program and fiscal year funding thresholds are reaffirmed.
10. Production quantity requirements are valid. What would be the impact on unit cost if actually budgeted dollars were cut below the optimum production rates? How closely tied to operational requirements are the proposed "optimum rates"? What alternative production schedules are reasonable and what costs are involved for facilities, and special equipment capitalization?
11. The possibility of multi-year procurement and its effect on cost has been considered.
12. Issues concerning producibility, reliability, configuration control, quality assurance, and facilities are identified and satisfactorily provided for.
13. The program management structure and plan for the full-scale Production and Deployment Phase are sound and adequately supported.
14. Major problems yet to be solved are identified and a satisfactory plan for their solution exists.
15. NATO standardization and interoperability requirements have been satisfied.

16. Required future production decisions have been identified and incorporated into the acquisition strategy and functional implementation plan.

17. Planning for deployment has been completed and is adequate, including manpower and training, logistic readiness, and operational considerations (including integration with existing operational systems).

18. The adequacy of the support subsystems being provided to meet the needs of initial operational units has been assessed, and plans have been prepared to meet any reported deficiencies.

19. The production readiness review has been completed and has determined that the contractor has adequate capability to manufacture the system and is prepared to commit the resources necessary to achieve the production rate required, to accomplish rework, and to furnish spares as necessary.

MILESTONE III

Milestone III Review Documentation (MRD)

The MRD required at Milestone III is the same as for Milestone II as described earlier.

Milestone III Review and Approval

The review and approval process at Milestone III is the same as described earlier and in Appendix A. Normally the Milestone III decision for ACAT I programs is delegated by the SECDEF to the SECNAV, if the thresholds established and approved at Milestone II are not breached. If thresholds and acquisition plans approved at Milestone II are not breached, no further OSD review is necessary for ACAT I programs. The approval level required for a less-than-major program may similarly be delegated downward.

PRODUCTION AND DEPLOYMENT PHASE

Production and Deployment Phase efforts will be directed toward providing and maintaining the desired operational capability and inventory. Production of hardware, system deployment, and the establishment of Fleet support operations will be accomplished through the plans already prepared by the program team and approved by higher authority. Figure 3-11 is an overview of the inputs, outputs, and principal activities of the Production and Deployment Phase.

Transition to Full-Rate Production

At the commencement of the Production and Deployment Phase, the PM should carefully review the SDDM/SNDM/SPRDD/DADM for any required modi-

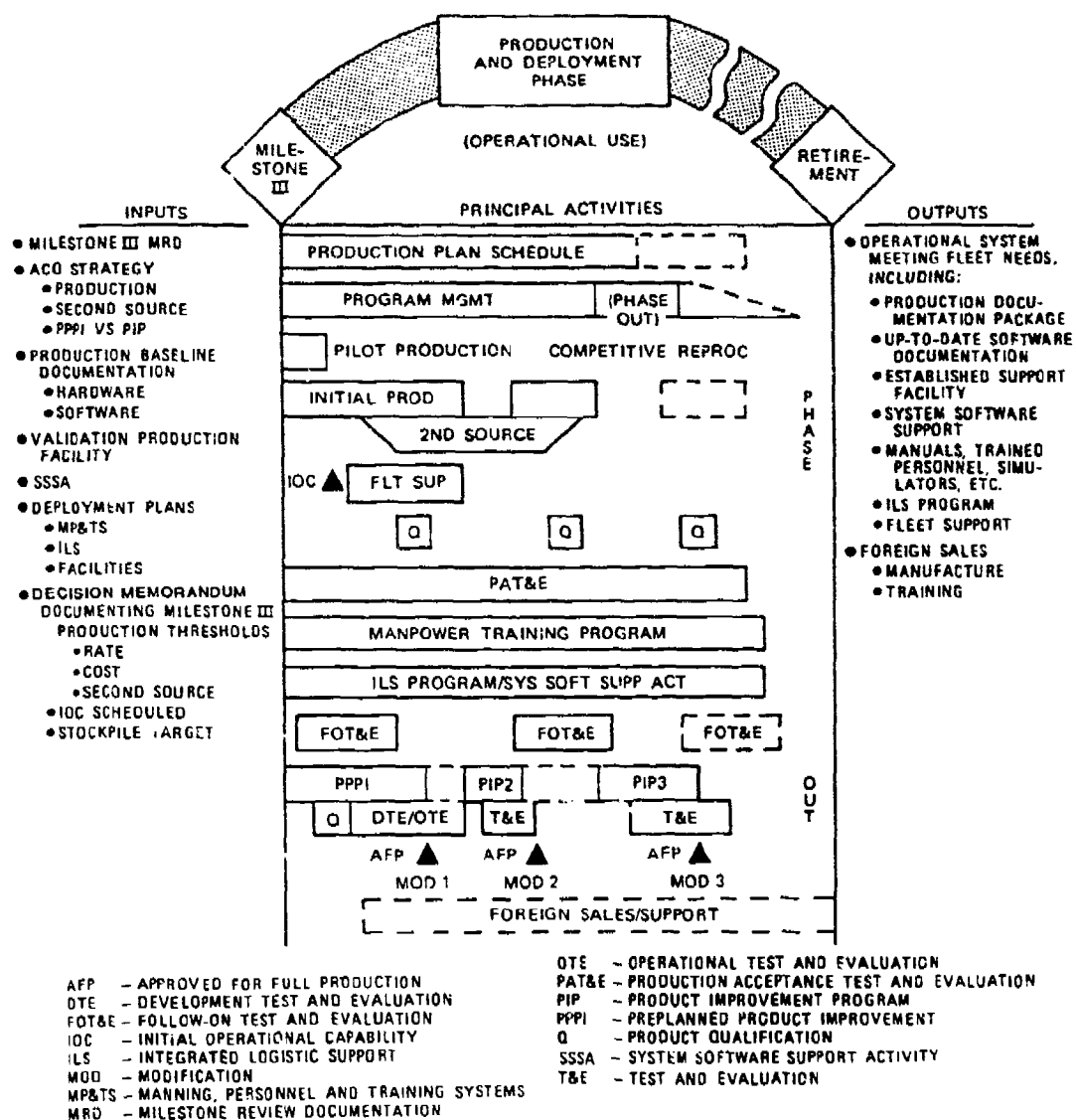


FIGURE 3-11. Inputs, Activities, Outputs of Production and Deployment.

fications, redirection, or restructuring of the program. Low-rate production may already have been initiated under a limited production decision, Milestone IIIA, prior to approval for full production and the rendering of a Milestone III decision. If not, the PM should proceed with procurement from the developing contractor, whose production capability will already have been established in the pilot-production program. The procurement schedule and the budget must be carefully coordinated to avoid long gaps between Milestone III and IOC.

Low-Rate Production Schedule. Initial low-rate production can provide the additional units as well as the time needed to confirm the adequacy of the product baseline and to qualify any design or production process changes that may be required (or that may have been deferred) before proceeding to high-rate production.

Low-rate production schedules are uneconomical and should be of short duration unless they are required by the budget or other obligation. To establish an acceptable low-rate production schedule, stepped increases in production rate quantities should be optimized in regard to the contractor's production costs, government in-house costs, and weapon system life-cycle costs. The most economical and/or "best schedule" should be arrived at through intensive cost analysis and trade-offs involving both budgetary and programmatic considerations.

Unacceptable low-rate production schedules result in excessive unit cost (both fixed and variable), and intermittent subcontractor/vendor procurements. The unacceptability of low-rate production schedules can only be determined after considering the cost to buy-out a specified quantity versus the cost to sustain a low-rate production including mobilization requirements.

Optimum Full-Rate Production/Economical Production Rate. Full-rate production provides the best means of amortizing fixed costs and achieving the lowest unit manufacturing cost. Full-rate production should commence as soon as the product baseline has stabilized and the contractor's capability is established.

Before committing the government for full-rate production, stepped increases in quantities should be optimized in regard to contractor's production costs, in-house costs, and LCC including shelf-life and multiple-source considerations. Contractor's production costs should address the constraints of tooling and test equipment rate capability, multiple shifts, and dedicated facilities (brick and mortar). In-house costs should address the impact on government production and storage facilities as well as administrative burden. Also, care must be exercised to avoid lost economic opportunity by over/under production of separately procured items. As with low-rate production schedules, the most economical and/or "best schedule" should be arrived at through intensive cost analysis and trade-offs involving both budgetary and programmatic considerations.

Unacceptable variations from the most economical production rate will result in higher overall cost, cause degradation of design integrity and/or quality of the end product, and in certain instances, outpace

the availability of other components of the system and thereby incur lost economic opportunity.

Maintaining Competition through Multiple Sources. Minimum quantities that can support multiple-source (second source) competition should be determined early and, where cost analysis indicate that total procurement cost can be reduced, provisions for a second-source program should be incorporated into the acquisition strategy. In addition to cost reduction, a better-defined and higher-quality product usually emerges. An increase of production capacity and surge capability is created and lower vulnerability to disasters due to dispersed production is obtained. Second- or alternative-source qualification should begin immediately, if it has not already been done, by contracting with competitively selected sources for a small number of systems or subsystems. Qualification tests of these systems will determine the new sources' compatibility with the documentation package. Once qualified, the new sources become eligible to participate in competition for subsequent buys on an equal footing with the development/pilot-production contractor.

Maintaining Rate Production of a Quality Product

In order to obtain and maintain rate production of a quality product for fleet use, it is imperative that the PM exercise stringent oversight of a number of critical areas. These include: configuration control, quality control (QC)/quality assurance (QA), control of nonconforming material, and recurrent problem/failure control. While the general aspects of these topics are discussed below, they are covered in more detail in Section 4, Critical Topics.

Most PMs are required to spend an inordinate amount of effort on these aspects of the Production and Deployment Phase. For each of these topics, an ounce of pre-planning and effort is worth pounds, dollars and months of effort in attempting cures.

Configuration Control. Configuration control during the development phases was intended to facilitate the design evolution process. Its practice was comparatively loose. By contrast, Production and Deployment Phase configuration control must be practiced rigorously. Changes should be allowed only when it can be justified by cost-effectiveness or for the correction of problems or failure. Even then the total impact of a change must be carefully assessed and action must be taken to accommodate all ramifications of the change. MIL-STD 480 controls the configuration change process and should be implemented in all production contracts.

Production contractors should be required to utilize and provide the program management office with Level 3 (MIL-D-1000A) engineering drawings and associated lists as a means of tightening configuration control and enhancing product maturation. The design of systems or components bought at a lower-level document package has not matured or gone through as stringent a government design review. Level 3 documentation review adds to the Navy corporate memory and facilitates second-source competition.

Maintenance of the package is especially critical to configuration control. The PM must ensure that the product baseline configuration reflects the current design at all times and that details of the changed configuration are routinely made available to activities who need information, such as contractors and maintenance personnel. Extra care is required when the product baseline configuration involves both (1) a function or performance specification and (2) a fabrication or design specification, in the form of product drawings, manufacturing processes and procedures, and in-process and acceptance test and inspection requirements. Many of the high-volume production weapons procured by the Navy fall in this category. When the acquisition strategy calls for competitive re-procurement to a rigorously controlled, government-owned and maintained data package, the program manager is advised to call upon one of the Navy laboratories or centers to assume responsibility for maintenance of the re-procurement data package. A laboratory or center that participated in the development phases is a natural candidate for this service.

Quality Control (QC) and Quality Assurance (QA). Primary responsibility for accomplishment of QC rests with the contractor; primary responsibility for assuring that the contractor's QC program is being properly implemented rests with the local DCAS or resident plant representative office (PRO); and responsibility for conduct of the PAT&E portion of the QA program rests with the representatives of the project contracting officer at the designated quality-assurance test activities.

The PM should enlist the service of a knowledgeable government activity such as a Navy laboratory to render assistance in:

1. Reviewing, approving, and monitoring contractor QC plans including implementation of the manufacturing screening fundamentals of NAVMAT P-9492.
2. Structuring and conducting government-sponsored QA programs.
3. Auditing contractor, Defense Contract Administration Service (DCAS), and test activity implementation of approved contractor QC and government QA programs.

While the emphasis placed here on QC/QA might seem to be an overkill, the importance of ensuring the delivery of a high-quality product with minimum latent defects into the service inventory is ample justification. Delivery of inferior products not only lays the groundwork for expensive and time-consuming inventory purging and rework programs, but robs the using commanders of their operational capability.

Nonconforming Material. The major cause of nonconforming material is the failure of the contractor to control his assembly procedures and material procurement. Improper material procurement by the contractor may include the failure to properly transmit contract documentation from contractor to subcontractor, and inadequate inspection procedures.

The PM should see that contracts contain a clause pertaining to "Configuration control; engineering changes, deviations and waivers". This is permitted by MIL-STD 480. This clause establishes a Material

Review Board (MRB), with the Government having final authority over all board decisions. The options for disposal of nonconforming material are use as is, scrap, repair, or rework.

The Government representative on the MRB is typically the DCAS/PRO. He is empowered to make decisions on the acceptance or rejection only of those waivers that do not affect form, fit, function, or safety. The DCAS/PRO may require technical assistance from the program management office or a supporting field activity to evaluate the impact of the nonconforming material on system reliability, performance, and safety, as well as the acceptability of corrective actions. Provisions should be made for ready access of the DCAS/PRO to such assistance.

Recurrent Problem/Failure Control. The identification and correction of problems and failures is critical to the production program. The contractor must be required to set up a closed-loop system that isolates and identifies problems and ensures that corrective action is taken. The problem-failure-recurrence control system should encompass:

1. Reporting problem/failure conditions
2. Collecting and classifying data and determining trends
3. Analyzing data and establishing probable cause
4. Taking corrective action
 - a. Recommended actions to preclude recurrence
 - b. Effective schedule
5. Verifying that corrective action is taken
6. Follow-up; i.e., how effective was action

The control system should not treat the problems and failures merely as random incidents, but should be designed to locate and eliminate the causes of each. Typical failure causes and appropriate action are illustrated in Figure 3-12.

Maintaining Competition through Component Breakout. Some systems will be of such low production volume or require such specialized production facilities that competitive re-procurement of the entire system will not be appropriate. However, there will usually be subsystems and components that can be broken out and procured competitively. Such competition in the procurement of subsystems and components should lead to lower procurement costs and, possibly, to improved characteristics. Component breakout will facilitate meeting small-business objectives as well as achieve additional cost savings by eliminating the prime contractor's middleman role.

These desirable features are not obtained without some drawbacks. Component breakout becomes increasingly risky with the heightened complexity of modern weapon systems and the reductions in personnel available to manage GFE. Frequently the prime contractor actively opposes component breakout. Reasons for this include: the prime contractor may feel that his expertise and management ability can effectively be used in selecting the component manufacturers and ensuring that their products meet his exacting standards (some contractor's standards are indeed higher than the government's) in order to ensure overall system reliability and performance. Late-supplied or defective government-furnished equipment can also have an adverse effect on the contractor's

internal operations as well as his reputation.

| FAILURE CAUSES | CORRECTIVE ACTION |
|-------------------|--|
| DESIGN INADEQUACY | INCORPORATE SUITABLE DESIGN CHANGES |
| DEFECTIVE PARTS | IMPROVE VENDOR CONTROL INCREASE INCOMING INSPECTION IMPLEMENT PARTS RESCREENING |
| TEST ERRORS | MODIFY TEST PROCEDURES/EQUIPMENT IMPROVE TRAINING FOR TEST TECHNICIANS |
| ASSEMBLY ERRORS | CLARIFY ASSEMBLY INSTRUCTIONS INCREASE INSPECTION POINTS IMPROVE TRAINING FOR OPERATORS/INSPECTORS IMPLEMENT NAMAT-P-9492 |
| PROCESS PROBLEMS | TIGHTEN PROCESS CONTROLS MODIFY THE PROCESS USE ALTERNATIVE PROCESS IMPLEMENT NAVMAT-P-9492 |
| MISHANDLING | USE ADEQUATE HANDLING EQUIPMENT INCORPORATE SUITABLE PACKAGING IMPROVE TRAINING FOR PERSONNEL MINIMIZE HANDLING |

FIGURE 3-12. Typical Failure Causes and Corrective Actions.

There is also a financial motive in resisting close government control of component breakout. Most contractors allow (and many prime contractors have adopted) accounting systems in which a profit factor is applied to the prices paid for subcontracted components as well as for administrative and engineering fees necessary to adapt and ensure fit of the components. Such accounting devices have been used even in cases where a government agency was the "subcontractor" for the items such as warheads and fuzes.

Deployment and Fleet Support

Planning for the smooth phase-in of a new system and phase-out of the old must be undertaken several years prior to actual commencement of the task. Although the mechanics of deployment are very equipment-specific, the need for careful planning cannot be overstated, particularly in regard to the training of needed personnel and the establishment and placement of system support. Fleet support from contractor or Navy laboratory personnel on first deployments is in most cases desirable and in certain cases necessary. These technical personnel serve the dual purpose of ensuring proper initial installation, servicing, and use, and of speeding up feedback from the user to the design agent.

Fleet support can be broken down into phase-in support, operations support, and phase-out support. The phase-in support period starts with the IOC date and ends whenever the full operational support is initiated. Phase-in support is normally procured at the same time as the equipment and most often will consist of contractor-supplied training

and initial spare parts. Warranty service and maintenance contracts also fall into this support category. The planning for phase-in support must be accomplished during the latter stage of the FSD Phase program.

Operational support is required throughout the service life of the system. There is a continuing need for a responsible agency for in-service engineering throughout the life-cycle of any system to represent the interests of the end user of the system and to direct contractor activity in repair, refurbishment and update/improvement of the system in question. Operational support requirements are initially predicted by the ILS tasks performed during the earlier phases. They are constantly corrected by the various support management effectiveness systems utilized by the supply system, training commands, operational commands, systems commands, field support activities, etc.

The support system is set up for long-term, continuous operations. It is, therefore, extremely important to properly plan the transitional support for a system. The planning requires not only the accurate execution of the ILS tasks but also ensuring that the funds and other resources are available to implement the approved ILS plans. Identifying funds requires budgeting actions that will take at least 2 years to produce the allocation. Identifying personnel resources may require changing manpower allocations and recruiting quotas, setting up training courses, scheduling a training pipeline, and it may take 3 or more years before the personnel are available. Since these are long lead-time actions that may exceed the time needed to procure the equipment, the phase-in support planning becomes very important.

All too often the planning for operational support is incomplete, especially in the identification of funding for training and spare parts. When the new system is put into the Fleet without proper planning or initial support, the unsupported equipment suffers abuses that often permanently degrade performance and reliability. Low system availability may cheat the user of a needed capability and cause the expenditure of manpower and dollar resources better spent elsewhere.

A frequently overlooked support requirement is the technical data needed to set up and utilize the available support management effectiveness systems. The most important of these systems is the maintenance data collection system (MDCS) portion of the maintenance and material management system. MDCS takes maintenance reports from the Fleet and computes logistic and reliability, maintainability, and availability (RM&A) parameters. The logistics parameters are straightforward calculations of usage and parts-demand data and are used to isolate and correct supply system deficiencies. The RM&A parameters are used to identify latent design, support documentation, training, installation, and manning problems, and insufficient test equipment allocations.

PRODUCT IMPROVEMENT

Rarely will the first production designs of a new system prove fully satisfactory. Changes in the threat, tactics, interacting systems, or new technical achievements may have occurred too late during the system development to be incorporated in the design. Deficiencies

may show up during Fleet use that were not uncovered during development or OPEVAL, or the development program may have been carried out on the assumption that a P³I program would be implemented to compensate for an early Fleet introduction of the basic system capability. Since it is rarely possible to field an optimized design on the first try, it is necessary to implement a vigorous product improvement plan (PIP) to include all the improvements that the ongoing development and production program could not incorporate on the first pass.

As a first step in developing the PIP, the PM and his staff should review their objectives in light of the compromises, design shortfalls, and discoveries made during the course of development and early production, and identify the subsystems, processes, and parts that could or should be improved. The PIP should provide a framework for identifying areas in which changes will be beneficial, and for implementing product modifications and procedural changes that will improve performance, producibility, reliability, safety, will decrease costs, will have any other beneficial results.

The PIP is conducted in much the same manner as the initial system development: investigation of need, review of alternatives, demonstration and validation of the changes, product engineering, follow-on test and evaluation, and possible re-release of the finished product with a new approval for full production. Documentation and configuration control are important. PIP modifications should not be introduced on a piecemeal basis and the necessary changes in the ILS, manpower, personnel and training systems (MP&TS), and other affected areas need to be coordinated. Provision must be made for the orderly expenditure of inventory and return of deployed units for modification. The supply system and the Fleet must know the state of the PIP at all times, particularly if significant changes in operational effectiveness have resulted. Support, training programs, and changes in recommended tactics must precede the deployment of the modified system.

PROGRAM MANAGEMENT OFFICE (PMO) PHASE-OUT

The program phase-out plans provide for the transition of continuing system tasks into functional organizations and for documenting the program history. The phase-out plan should incorporate a WBS and should show the completion dates and the person or organization responsible. Continuing or recurring tasks should show who were responsible in the program organization and the persons or organizations assuming the responsibility. The coordinating plans or documents and any other pertinent data should be referenced, and storage points and holders should be cited. Common documents would include, as a minimum, the ILSP, training plans, configuration baseline and data, and re-procurement data. The historical section should include a listing of all permanent program documents, reports, and data. These items should cover the design and development, testing, acquisition, ILS, installation, initial field data, quality and workmanship, and actual costs and schedules compared to the planned targets. Any significant achievements of the program, significant problems, and any lessons learned should be incorporated in a narrative. Any innovations or patents should be mentioned. The program's successes and failures provide valuable les-

sons for the many similar programs that will follow, and can also point to areas in which organizational policies should be improved.

SYSTEM PHASE-OUT

The most overlooked support phase is phase-out. Usually, a system is phased out because a replacement system is being phased in. As a system nears the end of its service life, various support elements become uneconomical and are dropped. Special training courses are ended, maintenance contracts are terminated, etc. In today's austere budget environment, the acquisition program for the replacement equipment can hardly be expected to assist a "lame duck" system. Most of the problems that can occur during phase-out can only be addressed early in the acquisition cycle of the particular system being phased out. Levels of repair and standardization should be established such that system-peculiar items are minimal and are not system-critical, and minimal skills are required to operate and maintain the system. A maintenance contract might be structured on a cost-per-unit basis. Consideration of the phase-out problems that may occur for a system being replaced by the current acquisition may make it desirable to alter the phase-in rate and hence the production rate of the new equipment.

CRITICAL TOPICS

Section 4

Section 4

CRITICAL TOPICS

THE MANAGEMENT PROCESS

"The most involved fact in the world could have been faced when it was simple, the biggest problem in the world could have been solved when it was small."

Lao-tzu (circa 550 B.C.)

The function of a manager is to identify problems while they are small, before any of the options that may exist for their solutions become unavailable, and to make the decision necessary to solve those problems. In practice, of course, the accomplishment of these two "simple" functions is much more complex. Any approach to the management process can be shown to consist of six iterative, sometimes commingled, steps. These are:

1. Establishment of an acquisition strategy
2. Establishment of a baseline plan
3. Measurement of progress
4. Comparison of actual progress to the baseline
5. Analysis of any variances between actual and planned progress
6. Making corrections

Establishment of an Acquisition Strategy

SECNAVINST 5000.1 states "Acquisition Strategy. From program start an overall plan to acquire, produce and support the system shall be developed and tailored to the unique circumstances of the program. It shall set forth the objectives, resources, principal assumptions, and contracting approach, including extent of competition. ...The acquisition strategy shall be executed with maximum tailoring, flexibility, innovation and common sense."

OPNAVINST 5000.42 states "Acquisition Strategy defined in broad terms ... includes not only elements such as contract type, competition, industrial base, etc. ... but also such elements as program structure, requirements, thresholds, priorities, resources, OT&E, etc. ... The foundation of acquisition strategy lies in these latter elements - particularly program structure ..."

Acquisition Strategy Development During the Concept Exploration Phase. The acquisition strategy forms the basis for the development of other program documentation (System Concept Paper (SCP), Decision Coordinating Paper (DCP), Integrated Program Summary (IPS), Navy Decision Coordinating Paper (NDCP), Test and Evaluation Master Plan (TEMP), etc.) and serves as a means for correlating individual program decisions with the Planning, Programming and Budgeting System (PPBS), Details of the

policies, procedures, format, and content for the acquisition strategy document are given in NAVMATINST 5000.29 ("Acquisition Strategy") and are available from MAT-021.

Selecting an acquisition strategy for a weapon system is one of the most important decisions in making the fielding of that system a reality. The acquisition strategy decision has far-ranging impacts on the possibilities of generating competitive cost savings and on the degree of success in meeting performance and schedule parameters. Since the decision and its outcomes are not obvious, the decision should be made only after careful considerations of available options. The potential strategies should be analyzed as to the various objectives they would affect or achieve and as to appropriateness for the special conditions of the specific system.

The acquisition strategy must serve as a responsive and flexible instrument for ensuring that adaptive approaches to the acquisition process are pursued. Emphasis is on near term, but the strategy will be constantly under development and will be updated periodically during the life of the program. As a practical matter within the PMO, the business manager is the focal point for the acquisition strategy. It is prepared by the business manager and PM with the assistance of the Command Deputy for Acquisition and Contracts and other functional specialists.

The acquisition strategy is submitted through the chain of command to the Chief of Naval Material (CNM) for approval. Once approved, the acquisition strategy becomes the contract between the PM and CNM relative to the acquisition procedures that will be followed. It also serves as a communication mechanism between CNM and higher authority concerning the acquisition approach being used.

NAVMATINST 5000.29 was issued to allow an approved acquisition strategy plan (ASP) to be used instead of a Request for Authority to Negotiate (RAN) in support of a Secretarial Determination and Finding (D&F) if the information required by paragraph 3-306.52 of the Navy Acquisition Requirements was included. This has not been the case. Typically, an acquisition or contracting plan which xxxxxxxx the ASP is prepared as well as the RAN/D&F. It should be noted that the Competition in Contracting Act of 1984 significantly changes this methodology. New instructions are in the process of being prepared.

Tailoring the Acquisition Strategy. The acquisition strategy must be tailored to the particular program's needs. Figure 4-1 outlines examples of tailored acquisition strategies.

Since each program has different requirements, it is impossible to detail all of the items requiring consideration in the preparation of every acquisition strategy. However, the acquisition strategy submitted to CNM would typically address the following:

1. Management concepts:
 - a. Use of organizational assets (Headquarters personnel, government laboratories, industry, universities, and others)

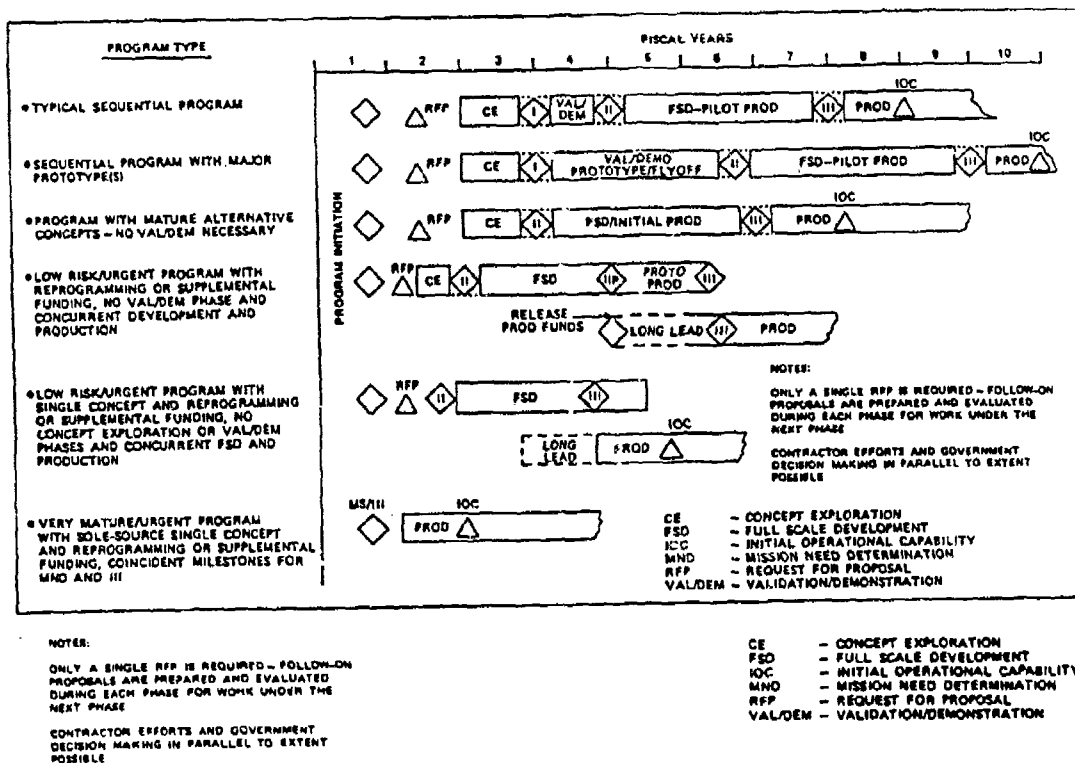


FIGURE 4-1. Examples of Tailored Acquisition Strategies.

- b. Planning and control of critical program activities
 - c. Establishing the baseline for the integrated logistics support plan (ILSP) and the TEMP
 - d. Identification of known-unknowns and their likely impact
 - e. Scheduling
 - f. Testing, demonstration and evaluation. What overlap of development test and evaluation (DT&E) and OT&E? What special T&E equipment and/or facilities are required?
2. Interdependence of effort with other programs:
 - a. Platforms on which the developing system is to be used
 - b. Other programs on which the program depends for technology demonstrations, fallback options, interface requirements, or components
 - c. Interservice or North Atlantic Treaty Organization (NATO) interoperability requirements
 3. Competition:
 - a. Methods for obtaining and maintaining competition
 - b. Into what phases should competition extend and at what level (system, subsystem, component)?
 - c. Will there be competitive procurement? Re-procurement?
 - d. How many and what kind of competitors?
 - e. Cost/benefit analysis

- f. How and when to transfer laboratory contributions/government-owned information to competitors
- g. Selection criteria for choosing best alternatives
- h. Funds available, timing

4. Contracting:

- a. Type of contract for each phase and rationale for its selection
- b. Contracting plan
- c. Preparation of solicitation for proposals
- d. Makeup of source selection and proposal evaluation teams
- e. Evaluation of proposals, criteria
- f. Use and handling of proprietary materials; how to obtain government rights to them; how essential is government control of the proprietary material?
- g. Contracting initiatives, use of contract incentives
- h. Monitoring contracts and contract controls

5. Design-to-cost and life-cycle costs (LCC):

- a. Methods for projecting LCC
- b. Goals for design-to-cost, when, how rigid
- c. Manpower, resources, logistics, energy
- d. When to start and fund product improvement programs

6. Budgeting considerations

- a. Realistic funding requirements (by phase) to achieve objectives, including land-based test support, T&E, and ILS
- b. Estimates of cost associated with cost growth during research and development
- c. Effect of decreased budget allocations on production rate, unit cost, program "stretch-out", minimal and optimal amounts required yearly for each phase

Functional Implementation Plans (FIPs). To supplement the approved acquisition strategy the PM must prepare and regularly update a series of FIPs such as those shown in Figure 4-2 on the next page.

It should be noted that Figure 4-2 addresses only those FIPs specifically called out in DODD 5000.1. Other FIPs may also be required such as those that cover contracting, LCC, configuration management, data management, maintenance and support, reliability, safety, and training. Other FIPs covering matter such as production and parts control may be required in later phases.

The FIPs should contain all major tasks, inputs, outputs, schedules, and sub-milestones, as well as manloading and the dollar-per-time estimates. Each task should be sufficiently detailed to permit accurate monthly progress measurement. Tasks should be updated as changes occur, and tasks should be added as new areas are identified and problems surface. The FIPs, together with comprehensive monthly status reports

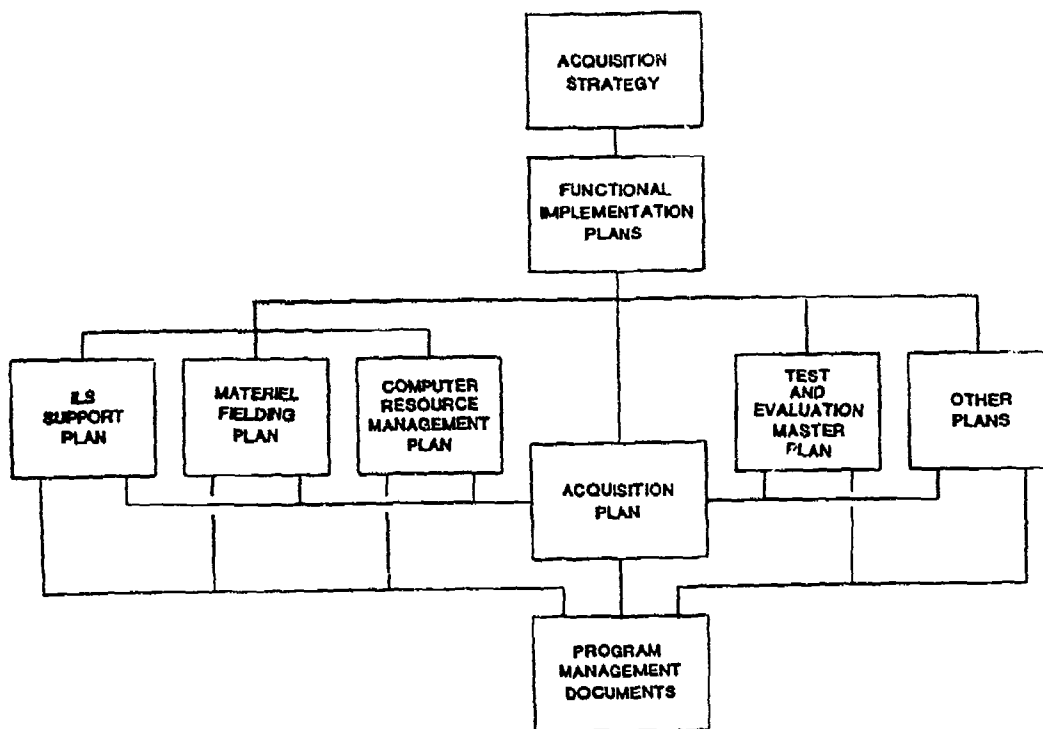


FIGURE 4-2. Acquisition Planning Relationships.

distributed to program members, can serve a valuable communication role.

Acquisition Strategy Update During the D&V Phase. During the D&V Phase, the acquisition strategy is updated to ensure that it follows the guidance received from higher authority during the Milestone I review process and with NAVMATINST 5000.29. The acquisition strategy should be broad-based and topically parallel to the Integrated Program Summary (IPS). It should contain the following:

1. A plan for defining the evaluation criteria for the demonstration and validation contracts.
2. A plan to ensure that complete specifications of compatibility requirements for interface between candidate concepts and related systems and equipment are promulgated to the competing contractors.
3. A plan for maximizing competition
4. A financial strategy with realistic maximum-minimum funding requirements

5. A plan for the use of Navy activities to assist in:
 - a. Developing government-furnished equipment (GFE) subsystems, e.g., warheads, fuses
 - b. Defining the evaluation criteria
 - c. Preparing the work statements and data requirements for the RFP
 - d. Providing technical information to the contractor
 - e. Evaluating contractor submissions
 - f. Defining the support and facilities needed for the next phase
 - g. Conducting in-process reviews of documentation
6. T&E requirements and criteria that reflect the particular needs of the demonstration and validation effort.
7. A plan for independently estimating LCC in sufficient detail for meaningful concept comparison.
8. A list of critical performance and technological advances that must be achieved in order to meet program goals.
9. A discussion of the specific approaches that the program manager will use in dealing with:
 - a. Untested technologies and other technical/cost/schedule risk factors
 - b. Hardware test data required to substantiate prediction
 - c. Material and components not currently being manufactured under established process control
 - d. "People functions" required for system operation and their compatibility with use conditions
 - e. Alternative or secondary functions of the system and their impact on the primary mission
 - f. Susceptibility of the system to the anticipated RF environment, hostile weapon systems, and electronic countermeasures (ECM)
 - g. Enhancing system survivability
 - h. Designing reliability and logistic supportability into the system

Acquisition Strategy Update During the FSD Phase. During the FSD Phase, the PM should conduct a comprehensive review of the acquisition strategy and Functional Implementation Plans (FIPs) (see later in this Section) in conjunction with a review of the decision authority's Milestone II decision memorandum. A procedure for this review is discussed under "Organizing D&V Phase Activities" (see Section 3). The updated acquisition strategy should include discussions on the following items:

1. Work Breakdown Structure (WBS). Delineate the level to which each breakdown is to be managed and for which cost reports are to be obtained. Also, establish the schedule of review (weekly, monthly, or quarterly, depending on criticality of the schedule or the degree of risk in the individual breakdown).

2. Life-Cycle Cost (LCC). Review and discuss the cost models, costing methods, and data review sources used in validating the estimate.

3. Management review and Tracking Procedures. Discuss the procedures to be used in tracking the progress of critical project activities; e.g., updating the TEMP, ILSP, FIPs, etc.

4. Risk Management. Reaffirm responsibility assignments for managing all facets of the project with special attention to high-risk areas. Review the status of currently identified risk areas to ensure that actions are planned to resolve risk areas. This may require additional laboratory tests and simulations, the establishments of "Tiger" teams, or the initiation of a redundant effort by other contractors or by Navy laboratories. The Total Risk Assessment Cost Estimate (TRACE), Program Evaluation Review Technique (PERT), or other management systems are useful for this purpose.

5. Competition in Production. Production competition has, until recently, been at the option of the PM. The trend now is to structure a competitive strategy or have solid, unassailable justification for sole source. The decision to compete or not revolves primarily around: (1) the cost of establishing and/or qualifying a second source; (2) the quantity of production units to be procured; and (3) the duration of the production phase, i.e., the number of years in which follow-on production contracts will be awarded.

If production competition is to be pursued, a method of technology transfer must be selected. Alternative methods include Form-Fit-Function, Technical Data Package, Directed Licensing, Leader-Follower and Contractor Teaming.

Factors which must be considered to determine the most appropriate method include the quantity to be procured, duration of production, complexity of the system, availability of data rights and maintenance philosophy for the system among others.

Additional considerations include the "mechanics" of selecting, educating and qualifying a second source, and the role the first source should play in the process; whether to use annual or multi-year production buys; whether to award production contracts on a winner-take-all or split-quantity basis, etc.

The PM should understand that the prime contractor will usually see the prospect of a second source (i.e., competition in production) as an unfavorable development. Therefore, the inclination of the prime will be to develop a strategy which will make a second source unattractive. Competition often results in a better product and better pricing. There is, however, a significant cost associated with establishing a second production source. Therefore, the PM must determine analytically early in his program whether the benefits outweigh the costs. If so, he should plan for that competition, should properly fund for initial second-source startup costs, and make sure that these funds remain intact. He should be vigilant with regard to any action which would impede competition. Where competition in production is planned, the PM

is strongly advised to prohibit proprietary claims that would preclude second-source production.

6. Component Breakout. Another means of introducing or maintaining competition is to require breakout of major subsystems or components for competitive procurement. These items may then be furnished to the prime contractor as GFM/GFE (see Section 3). Normally, it is not desirable to allow the prime contractor to purchase these major components unless the prime has expertise that justifies the substantial additional cost for handling (up to 50%) plus profit. In some cases, it may be desirable for the Navy to act as system integrator.

7. Design Ownership. Within the acquisition strategy, the issue of design ownership and the use of proprietary components should be addressed early. The issue can be controversial and politically sensitive and should be resolved with a well-justified, documented decision. The lower the level of design ownership by the government, the more expensive and difficult that ownership becomes. Specifically, the government must procure more documentation and must assume the responsibility for its accuracy when its use is made mandatory in the production of an item. If proprietary parts and processes associated with items using sophisticated technologies are not excluded from the government-owned portion of the design, the government must obtain license and documentation for those parts and processes or be satisfied with a permanent sole-source situation, thereby lessening the advantage of design ownership. The government must develop rigid acceptance tests when internal proprietary components are used by the contractor, as these components are not subject to direct government control and may be changed at the vendor's discretion.

Establishment of the Baseline Plan

A good baseline plan is essential to the effective management of a program. It is the PM's perception of where he is going and it is not only necessary that the baseline plan be complete, but that it also be organized in such a fashion that it can be readily used. In particular, it is important that the structure of the baseline plan displays the relationship among various project elements clearly and present a suitable matrix for organizing compatible accounting and other reporting systems.

The accepted method for achieving a suitable organized baseline is through the use of the work breakdown structure (WBS). It is an extremely useful tool for organizing the baseline, for structuring accounting and other reporting and assignment systems, and for use in other applications such as life-cycle costing. If properly conceived and employed it can be the key to effective operation of the management process.

Work Breakdown Structure (WBS). MIL-STD 881 defines a WBS as "a product-oriented family tree composed of hardware, services and data with result from project engineering efforts during the development and production of a defense material item, and which completely defines the

project/program. A WBS displays and defines the product(s) to be developed or produced and relates the elements of work to be accomplished to each other and to the end product."

The WBS provides a technique for subdividing a total program or portion thereof into its component elements. These can then be displayed in a manner that shows their relationship to each other and to the whole. It is a basic framework which assists in systematic organization for program planning and management control at all levels of management.

The way to develop a WBS is described in MIL-STD 881 and deviations from this standard must be identified and explained in the Integrated Program Summary (IPS) (see page 3-XX). The WBS is organized in tiers, or LEVELS, each composed of a number of discrete items, or ELEMENTS. The top tier, a single element, is Level 1, the next, Level 2, etc., with the elements of each succeeding level being subdivisions of the elements of the preceding level. An example is provided in Figure 4-3.

Program Summary WBS. While a WBS can, theoretically, be carried to almost any level of detail, it can quickly become too cumbersome and unwieldy to be of practical use if carried too far. For this reason, the WBS most used by PM is an abbreviated version called the Program Summary WBS. The Program Summary WBS usually consists of the first three levels of the WBS. In some instances, portions of the Program Summary WBS may be extended to the fourth level, but rarely beyond that. Such a Program Summary WBS will identify the "hardware" elements of the program and their subsystems (these elements are sometimes called "mission hardware" elements) and the elements necessary, at the system level, to support the development, production, and service use of those products (these support elements are sometimes called "generic" elements). The level to which the Program Summary WBS is carried will probably be determined by the levels of the elements where the PM plans to assign major responsibility to a contractor or to a Navy Field Activity or other government organization.

Contract or Subprogram WBS. When a PM decides to assign responsibility for the effort and the results to be achieved under a given Program Summary WBS element to a contractor, DOD policy dictates that, for any sizable effort, a separate "Contract" WBS be developed for that effort. The Program Summary WBS element representing that effort will be the first level element in the new WBS. Frequently, the development of the Contract WBS is a two-step process.

The first step is the development of a normal, three-level WBS to be included as a part of the contract specification to assist in defining the scope of the effort desired. This Contract WBS may be modified during negotiation of the contract, but should be retained as a management tool during contract execution.

After the contract has been let or, in some instances, during its negotiation, the contractor should be required to expand the Contract WBS to additional levels of detail. The amount of expansion will depend upon the level to which visibility is desired and control is to be exercised.

In those instances where responsibility for a major Program Summary WBS element is assigned to a field activity, a Subprogram WBS should be developed in cooperation between the field activity and the program management office (PMO). It should be used for the same purposes and in a similar manner to the Contract WBS. Any comments made concerning the Contract WBS will, normally, be equally applicable to the Subprogram WBS.

A Contract WBS will usually emanate from a mission hardware element of the Program Summary WBS. Such a Contract WBS will contain both mission hardware elements and generic elements, the former being further hardware breakdowns and the latter representing the support required at the hardware subsystem level from which the WBS is being developed. A useful tool for assuring that all the proper generic elements are included is a WBS element matrix, as shown in Figure 4-4, in which the mission hardware elements of the Project Summary WBS are along one axis of the matrix and the generic elements are along the other. This allows ready visualization of all generic elements that might be involved, for decision as to whether or not they are required at that subsystem level.

Program WBS. The complete WBS for the program is made up of the Program Summary WBS plus all of the Contract/Subprogram WBSs emanating

| <div><div>GENERIC ELEMENTS</div><div>(LEVELS AS REQUIRED)</div><div>MISSION HARDWARE ELEMENTS</div></div> | INTEGRATION AND ASSEMBLY | | | | INTEGRATED LOGISTICS SUPT | | | | SYSTEM SUPPORT FACILITIES | | | | SYSTEM DATA | | | | OPERATIONAL ACTIVATION | | | | SYSTEM ENGINEERING | | | | SYSTEM PROJECT MGMT | | | |
|---|--------------------------|-----------------|------|-----|---------------------------|----------------------|-----|-----------------------|---------------------------|-----|------------------|------------------|-------------|-----------------------|-------------------|-----|------------------------|-----------------|-----|---------------------------|--------------------|-----|--|--|---------------------|--|--|--|
| | SYSTEM T&E | T&E ENGINEERING | DT&E | ETC | SUPPORT ENGINEERING | MAINTENANCE PLANNING | ETC | INDUSTRIAL FACILITIES | TRAINING FACILITIES | ETC | ENGINEERING DATA | TECHNICAL ORDERS | ETC | AIRCRAFT INSTALLATION | SHIP INSTALLATION | ETC | REQUIREMENT DEF | SYNTHESIS ENGRG | ETC | PROG PLANNING AND CONTROL | CONTRACTS MGMT | ETC | | | | | | |
| GUIDANCE MISSILE SUBSYSTEM | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GUIDANCE SECTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CONTROL SECTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ORDNANCE SECTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETC | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LAUNCH SUBSYSTEM | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LAUNCHER | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LAUNCH CONTROL | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETC | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LAUNCH PLATFORM SENSORS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FIRE CONTROL SUBSYSTEM | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SURVEILLANCE/ACQUISITION | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBSYSTEMS ASREQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETC | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

FIGURE 4-4. WBS Element Matrix.

from it. This Program WBS forms the framework within which the baseline plan is developed and the rest of the management process is executed. Note that a Contract (or Subprogram) WBS may be the expansion of an element in another Contract (or Subprogram) WBS if the manner in which responsibilities are delegated and the requirement for visibility and control make it desirable to do so.

Assignment of Responsibilities. Obviously, no person can do everything, or even oversee every detail in a program of any size or complexity. The PM must therefore delegate responsibility for various aspects of the program and he must do this in a logical, unambiguous manner. The WBS breaks out program objectives and functions in a way that simplifies the identification of specific, logical responsibilities that may be assigned to individuals or organizations. A useful tool for applying the WBS to this purpose is the accountability matrix, as shown in Figure 4-5, in which WBS elements are displayed along one axis and the program organizational structure along the other. Use of this matrix provides excellent visibility for logical assignment, and also allows secondary, support responsibilities to be displayed/identified as well. In some instances, use of this matrix will assist in determining the level to which the WBS should be carried.

Plan Elements. The WBS elements at the lowest level in each portion of the Program WBS form the basis for the development of detailed plans. (For reasons which will become apparent later, these terminal elements are often called COST ACCOUNTS.) However, a WBS element addresses program end-objectives; what has to be accomplished, not how it is to be done nor when it is to be done nor what resources are required to do it. These latter items are, of course, basic to any plan and must be addressed in relation to the objectives of each cost account element. This can be done by defining a series of WORK PACKAGES associated with each cost account.

Work Package. The Work Package is not a further detailing of the WBS. Rather, it represents a portion of the actual work that must be done to achieve the objectives related to the associated cost account element. Each Work Package represents a unique segment of the work to be done at the level where it is to be performed. It defines the activities which must be completed to achieve a specific physical accomplishment. Obviously, for it to be unique, the start of any Work Package effort must be based on some other, external, physical accomplishment. The time it will take and the resources necessary to carry out each activity can be estimated fairly accurately and, hence, a schedule and a budget can be established for the Work Package. This in turn can be integrated into the overall program schedule. Additionally, in order to make achievement more visible and easier to manage, each Work package should span a relatively short period of time and should be assigned to a single individual or organizational segment.

Level of Effort (LOE) Package. Unfortunately, in every program there are certain types of effort that cannot be fitted into a true Work Package. Generally, these efforts do not result in a specific identifiable physical accomplishment and tend to span all, or major portions of

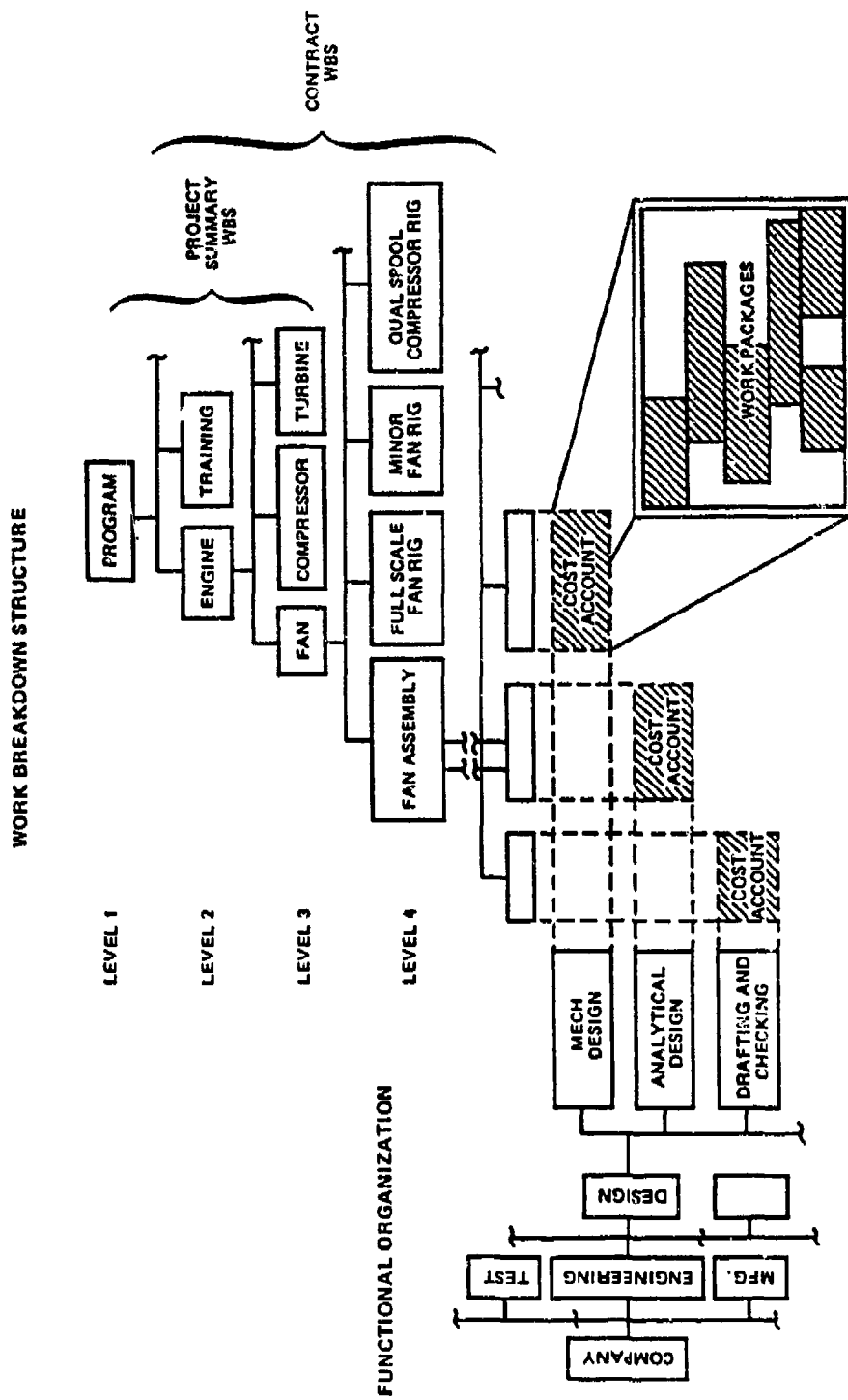


FIGURE 4-5. Accountability Matrix

a program schedule. Day-to-Day program management is a good example of this type of effort. Even though there may appear to be no tangible, objective-oriented achievements from these LOE packages, they are necessary and they do consume resources, so they must be included or accounted for in any plan. However, care must be taken to assure that any LOE Packages that are included are, indeed, LOE and not the mis-definition of one or a series of Work Packages. Because it is usually more difficult to specify LOE Packages, it is more difficult to control the effort that may be attributed to such Packages.

Plan Integration. Once all the requisite Work Packages and LOE Packages have been identified and defined and the time span, resource requirements, and interrelationships have been specified for all the related activities, they can all be put together into a master baseline plan for the program. In theory, this is a relatively simple matter, although perhaps a bit tedious for a large program. In practice, it is not all that easy unless computerized "management systems" are used. Indeed, DOD policy (DODD 7000.1 et seq) requires that contractors on major programs utilize a "Cost Schedule Control System" that satisfies specific, detailed criteria. No such requirement is currently placed on government activities (although there may be some faint stirrings in that direction), but it is reasonable that the PM do so for his program. The systems used by all major participants in a program need not (and perhaps, should not) be identical, but the output data provided by each to the PMO should be similar in content, if not in format. Just what that output should be is defined in DOD instructions and will only be outlined briefly here.

Budget. Estimated costs of the effort defined in the Work (and LOE) Packages should be accumulated at the cost account level. These can, and should, then be combined to provide budgets at higher levels (contract or subprogram) up to the total program. These should be capable of being broken out by various types of cost (labor and overhead, materials, procurement/contracts, travel, etc.) as appropriate to the program and the level of accumulation. Especially important is the ability to identify the estimated cost of the effort scheduled to be accomplished at any point in time. DOD usage terms this "Budget Cost of Work Scheduled" (BCWS) and it is used in later steps of the management process.

Schedule. Each Work Package activity will have a scheduled start and completion date, determined by the interface relations with other activities. These activities, in turn, may be accumulated and summarized to provide manageable schedules at higher levels. An important adjunct to any schedule is an indication of how important it is to complete any given activity on schedule.

Most "management systems" used in plan synthesis will determine, for each activity, how long the completion of that activity may be delayed before it will cause the end-date of the program, or program segment, to slip. This quantity is variously called "slack" or "safety" or something similar, depending on the system or local usage. Obviously, the completion of those activities for which this quantity is zero is critical to the completion of the program on schedule. Hence, any

activity having a zero slack is said to lie on (or be a part of) a CRITICAL PATH. It's delineation is a very useful feature and should be required.

Program end objectives are identified in the development of the WBS. In the development of the plan, intermediate objectives are either imposed on the plan or arise out of logical plan development. It is useful to identify and display these as "milestones" in the plan with scheduled dates of accomplishment. The best known of these milestones are the major review/decision point milestones separating program phases and defined in DODD 5000.1. Other milestones are intermediate to these and, more often than not, represent achievement in only one facet of the program. The identification and use of milestones is valuable in providing short-term incentives and additional visibility for specific technical achievements.

Responsibilities. The assignment of responsibilities to the cost account level was discussed above (Assignment of Responsibilities). These assignments, extended, perhaps, to the Work Package or activity level, should be integral to the plan.

Measurement of Progress

The third step in the management process is the determination or measurement of progress made. In general, there are two aspects of progress that need to be determined, resource expenditure and technical accomplishment. The PM must avoid the tendency to develop unique reports when existing data/reports are adequate to ensure control.

Resource Expenditure. Resources whose expenditures should be measured include funds, manpower, materials and services. In some cases, the latter three may be considered to be subsets of the first and their expenditure measured or recorded indirectly in terms of monetary costs. In others, they may be determined more directly. In any case, it is essential that the system established to measure and record these quantities be structured in such a manner that the measured values can be used directly and readily in the comparison, analysis, and decision phases of the management process.

Fund Expenditures. The WBS which is used in structuring and developing the baseline plan should be used directly in structuring the accounting system for recording costs relative to accomplishment. For this purpose, an account should be set up in the accounting system of the responsible organization to accumulate the costs of all effort associated with each of the terminal WBS elements for which that organization has been assigned responsibility (hence the term COST ACCOUNT for these terminal elements).

Other Resource Expenditures. Accumulation/recording of these expenditures should be organized by WBS cost account elements in the same manner as for costs. Indeed, if reporting of these expenditures by their cost is sufficient, the whole thing can undoubtedly be done by the same accounting system. If, on the other hand, man-hours or numbers of

hardware components or the like is required, some other system may be necessary. Any major contractor or government field activity will have the capability to do this, but the requirement must be specified from the outset to preclude confusion and/or costs at some later date.

Technical Accomplishment. Technical accomplishment should be measured at the Work Package activity level. Two aspects of activity accomplishment must be determined; first, how much of the activity has been completed and, second, what the results of that completion were.

Measure of Activity Completed. In some instances, the measurement of activity completion can be a relatively subjective determination, so the best estimate will usually come from the individual actually doing the work. The question asked should not be "how much of the activity has been completed?" but rather, "how long will it take to complete the activity?" In theory, these two questions may seem to be equivalent. In practice, the answers frequently are not; and the second question is really the one that is more significant in assessing program status. For use at the program level, it is usually advantageous to translate this time-based status indication into one with a monetary base which, in DOD parlance, is called "Budgetary Cost of Work Performed" (BCWP).

BCWP is what had been planned to be spent for the effort actually accomplished and, when combined with other factors to be discussed later, can be a very powerful indication of the relative "health" of the program. Every contractor with an approved Cost/Schedule Control System has an "acceptable" method for determining this quantity. It is absolutely necessary for the PMO to understand just what that method is in order to use the indicator effectively.

One method involves assigning 50% of the budgeted cost to an activity as soon as effort under the activity is started. The remaining 50% is assigned only when the effort is completed. This is a simple method to implement and, where relatively short-span low-cost activities are involved, it is probably reasonably accurate. However, in instances where spans of significant length are associated with significant costs, "lead-lag" situations can occur which may distort the true picture.

Another method involves assigning a percentage of cost equal to the percentage of the activity estimated to have been completed (that is, assume costs to be linear with time). This can be a more reasonable approximation so long as activities have not been assigned in too gross a manner and significant material costs are not involved. In the first case, it is probably wise to have each activity examined to assure that it is really a homogeneous entity. (For example, an 8-week activity labeled "test" might really consist of 3 weeks of test planning and preparation at a low level of effort, 2 weeks of intense activity for actual testing, and 3 weeks of more moderate effort in data reduction, assessment and report preparation. For better visibility and more positive control, it would probably be better to break the one activity into three.) In the case of material costs, it is probably desirable that they be assigned separately in a manner analogous to that in which actual costs are accumulated, since comparison is usually more significant than absolute value.

Verification of Results. In most well-planned programs, means to verify that the results specified for the program effort are being achieved are built into the program. Indeed, a major portion of any acquisition program is devoted to demonstrating that the system-of-the-moment meets - or does not meet - program objectives. For example, if a Work Package consists of a design-fabricate-test cycle for some component, the sole purpose of the fabricate and test activities is, probably, to verify that the design satisfies program/system requirements. It is still necessary, however, to assure that the plans for tests and numbers of units to be tested are satisfactory, that test items are properly built to adequate documentation, and that the tests are carried out as planned.

The most obvious method for gathering this information efficiently is by means of periodic review meetings where technical progress can be reported and discussed. These can be held at almost any level of the program - element, contract/subprogram, program. They can also be held for the discussion of a single problem and at intermediate times when it appears desirable to do so.

The achievement of a milestone is a significant event in program effort and must be recognized. However, intermediate milestone attainment must be used carefully, in conjunction with other measures, in assessing program status to assure that the aura surrounding such an event does not obscure deficiencies in other, unrelated portions of the program.

Comparison of Progress with Baseline

This step consists, essentially, of comparing the results of the first two steps against each other. In any very large or complex project, the problem is to present these results in a manner that makes differences between the two visible and meaningful. General means for doing this include the use of numerical indicators and graphical representation.

Numerical Indicators. There are several numerical indicators that can be very significant in any comparison of progress to plan. Three of these are measured in dollars, allowing unambiguous comparison. They include the BCWS which is included in the plan information, the actual cost of effort accomplished to that point (Actual Cost of Work Performed (ACWP)) which is measured directly in the previous step, and the translation of technical progress to monetary terms discussed previously, BCWP. These indicators should be derived at the WBS cost account element level, but can be combined/accumulated to any higher level. Normally, the cost account level will provide the greatest visibility and understanding. Among these three indicators, there are two comparisons that are very useful.

Cost Variance. The comparison of ACWP and BCWP is the first of these. The difference, $BCWP - ACWP$, is called the "cost variance" and is the amount by which the budget for the effort actually accomplished has been underrun or overrun. This can be presented as a percentage, if desired, by dividing by BCWP (and multiplying by 100). Cost variance is

often used by the Secretary of the Navy (SECNAV) and the Office of the Secretary of Defense (OSD) to track a program's progress. Significant variance will probably result in a request that the PM explain the cause of the variance and what steps are being taken to correct it.

Schedule Variance. A similar comparison between BCWP and BCWS produces a numerical "schedule variance." This indicator does not have the same type of direct significance that the cost variance does, but it does provide a way to highlight situations where effort is behind or ahead of schedule.

Caution. There is a temptation, if not a tendency, to compare ACWP with BCWS. This should be avoided as it has no real meaning and can lead to erroneous interpretations of program fiscal status.

Critical Path Variances. After progress is entered against program activities, a sort of "net slack" can be calculated for any activity that is not on schedule. This quantity is derived from any progress on the activity, the original slack for that activity, and the date on which status is being determined. The significance of this net slack is exactly the same as it was for slack in the original plan, with one exception. It is possible to have a negative value for net slack. A negative value means that delay in the associated activity has already caused a slip in the project end-date if nothing is done about it. Obviously, the largest negative value represents the total projected program slippage. Note that some management systems do not provide a net slack, but, rather, establish a new schedule adjusted to account for whatever activity slippage there may be. Some systems provide both.

Graphical Presentations. There are a variety of ways in which plan and actual information may be presented graphically. In general, these fall into two different types, one presenting schedule information and the other, budgetary. There are also ways to combine the two on a single graph, but that will not be discussed here.

Schedule Graphs. There are two general types of graphs commonly used in presenting schedule information, the Program Evaluation and Review Technique (PERT) type network and the Gantt "bar" chart. The choice of a graphical format depends on many things. However, for the display of schedules and schedule progress, some sort of a bar chart, shaded to show progress and with an appropriate symbol to indicate slack, probably provides the greatest visibility and ease in recognizing deviations from plan and their significance. The bar chart may, also, be best suited for summarizing the lowest level detailed charts into charts presenting higher levels of aggregation. However, the versatility and genuine usefulness of the PERT type network in highlighting interactions and potential schedule problems make it the preferred technique for overall management. It is generally well worth the cost and effort required.

Budgetary Graphs. Again, there are a variety of possible types that may be used, but the most informative and readily understandable may be the simple plot of cumulative expenditures versus time. It is useful in this type plot, to plot BCWS, BCWP and ACWP on the same graph.

Cost and schedule variances are immediately obvious as are their relative importance. These charts can also be readily plotted to show any level of the program from the individual cost account to the entire program.

Technical Results. Results of tests, analyses, or other activities with identifiable outcomes are normally compared against performance requirements included in or derived from program objectives. In some instances, results will be in a "go, no-go" mode; in others, actual variations are measured.

Analysis of Any Variances between Actual and Planned Progress

Although it is essential to recognize the existence of a problem, it is obviously not enough. (The mathematician would say "it is necessary, but not sufficient.") Additional information is needed: what caused it to occur, what will be its impact on the program, and what can be done about it. The importance of thorough variance analysis cannot be overemphasized since it is critical in the management of progress made.

Cost and Schedule Variances. Analysis of these variances should be done at the WBS cost account element level. Specific criteria need to be established as to when an analysis is required. Some percentage variance threshold (say 5 to 10%) is an easy way. It is important that this limit be tight enough to assure that incipient problems are identified early, but at the same time be loose enough to prevent every normal, insignificant perturbation from triggering the system. In practice, it is probably wise to specify (in a contract or a task assignment) a threshold that is a little more severe than is necessary and then relax it as experience indicates. The analysis itself must provide as complete a picture as possible. As noted above, there are at least three questions that must be answered:

1. Why did the variance occur? It could be the result of the unavailability of some resource, manpower (or the right manpower), special equipment or facilities, or funds. It could be the result of some technical difficulty, either internal or external to the element. It could be due to delays in other efforts so that inputs were not available on time. It could be poor planning. Whatever the reason, it should be identified precisely and reported concisely.

2. What will be the consequences of this variance if corrective action is not taken? Cost overruns and/or schedule slippages are common results, but technical effect and impact on the achievement of element or project objectives can also be involved. Again, the projected effects should be specific and reported briefly.

3. What is being or can be done to remedy or ameliorate the situation? If the situation can be resolved satisfactorily within the limits prescribed for the management segment (e.g., contractor or field activity) responsible, the solution should, normally, be implemented at

that level and be reported promptly. (The PM obviously, may veto that approach and require another.) If the solution lies outside the bounds of the authority delegated, the various options available should be identified and presented to the manager having that authority for decision.

Normally, the measurement/analysis process involving the cost and schedule variables will be performed at regular intervals (perhaps monthly), but a special report could be requested at any time that external influences or technical problems make it desirable.

In addition to the cost and schedule effects at the cost account level, they should also be projected for the entire contract or subprogram for eventual incorporation into overall program estimates.

Estimated Cost at Completion (EAC). This is an important parameter in most programs, the "bottom line" as it were. This consists of a known quantity (ACWP) plus an estimate of costs to be incurred over the rest of the program. This estimate can be made in a number of ways, any one of which may be reasonable. It is important, however, that the method used be known to the PM, and that the reason for its selection are logical for that program.

One method is to re-examine all activities not yet completed and re-estimate what each will cost. This is cumbersome and may not be worth the effort, since individuals do not always learn from experience.

A second method assumes that cost experience to date will be exactly reflected in future efforts. That is, if the effort under a given cost account has, to date, cost 20% more than was planned for it ($ACWP/BCWP = 1.2$), then the EAC for that cost account will be 20% more than originally budgeted. The EAC for the total contract or subprogram of the program as a whole will, then, be the sum of the EACs for the individual cost accounts. This is relatively easy to apply and is probably accurate method if any unusual circumstances (either past or future) are identified and proper adjustment made.

A simpler, although, possibly, a little less accurate version of the second method would use the $ACWP/BCWP$ ratio for the entire contract/subprogram as a multiplier for cost estimates of all future effort.

Analysis of Technical Variance. This is probably the most crucial type of analysis involved in the management process. It is the one where assistance of other technical experts may be required (Navy field activities provide a good source). It may also require some restructuring of the program merely to determine the cause of the variance. Note that any significant technical variance will always result in cost and schedule variances. The converse is not true. Note, also, that any significant technical variance should be reported immediately without waiting for normal periodic reports, and the necessary analysis should be started at once.

As with other variances, the same questions need to be answered: What caused it? What is its impact? and, What can be done about it?

Making Corrections

This is the pivotal step in the management process, the decision point. On the one hand, it is the culmination of one planning, measuring, analyzing cycle and, on the other, it is the beginning of the next cycle, since normally it results in some modification to the baseline. This is also the step that makes the PM "earn his pay". He should remember that he is not working alone and that he has many resources both within and outside the Department of the Navy (DON) to assist him. It is particularly important that the PM listen to the staff and the Government support activities prior to making his key decisions. It is essential that his decisions be logical, be based on the best technical advice, and be timely. The success or failure of the program depends upon this.

CONTRACTING

Contracting Process

As noted earlier, the PM must assign responsibilities for various portions of the program to organizations outside the PMO. Navy acquisition policy requires that industry be relied upon heavily during the development stages of a program and almost completely for production. However, the government has certain responsibilities which cannot be assigned to industry. These include the determination of agency needs, sufficiency of the technology base, effective program management, and decisions as to operational use. Similarly, industry, in general, has responsibilities in the acquisition process: providing the requisite technical capability, competently managing their resources, and developing and maintaining the capacity to economically produce the item. The specific responsibilities of industry are those defined by contract.

The contract establishes the relationship between government and industry. It must define the objectives, responsibilities, and authority of each party and provide positive control with adequate flexibility for timely modifications. Figure 4-6 illustrates the government/industry relationship. The key to program success is a "good" contract.

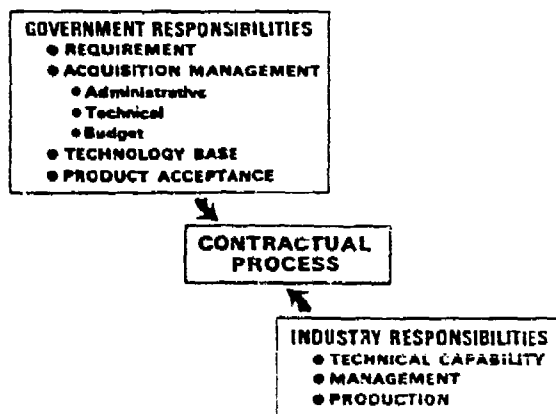


FIGURE 4-6. Government/Industry Relationship.

In one sense, the management of contracted effort is no different than for any other effort. The five-step management procedure discussed under "The Management Process" in this Guide is certainly applicable. In another sense, however, contracted effort is very different. The legal aspects of the contract and all the contracting process impose constraints that must be understood and observed by all parties to the contract. The PM must recognize that the contractor's incentives are, naturally, different in some respects from those of the government and his understanding and appreciation of operational requirements and constraints on the product are probably imperfect, at best. Considering these together, several points deserve emphasis:

1. The PM bears the ultimate responsibility for meeting program objectives, not the contractor.

2. Contract provisions and language must assure that the PM and his technical management representatives can exercise the necessary control over the contract effort. Especially important are plan approval, monitoring of effort, and the making of significant decisions.

3. The PM must not surrender any of his prerogatives to the contractor - something easy to do through inattention or inaction.

4. It is imperative that the PM have technically competent government personnel to advise and assist him.

5. The contracting process is time consuming. A multitude of legal and procedural requirements must be met. The PM must recognize this, provide the requisite time for these actions in his plans, and, with his team, exert pressure at all time to keep the process on schedule.

6. The PM should be directly involved in:

- o Developing a contracting (procurement) team
- o Selecting sources and negotiating contracts
- o Fostering competition
- o Managing contracts

Types of Contracts

It is Department of Defense policy that contract types be employed that are appropriate, considering all the facts and circumstances involved in a specific acquisition. The principal distinction between various contract types lies in the degree of risk assumed by the parties and in the apportionment of responsibility. To the extent that the selected contract type reflects a fair and reasonable apportionment of risk and responsibility between the government and the contractor, the contract is more likely to facilitate the efficient conduct of a program. When unilaterally imposed as a substitute for effective program management, either by inadvertence or by design, an inappropriate contract becomes the source of needless, unproductive, and costly controversy.

It makes little sense to place unreasonable risk upon industry by

means of firm commitment negotiated at high prices, but unenforceable in practice or in fact. Firm commitments at high prices tend to make total acquisition program unaffordable, and attempts to enforce such contracts may generate senseless adversarial relationships that are almost inevitably detrimental to the interest of all the parties.

Basically, there are two types of contracts: fixed-price and cost-reimbursement. The major distinction between the two is in the nature of the seller's obligation and risk. Under a fixed-price contract, the contractor must produce the required items or perform the specific service for the fixed price (or within the ceiling price of an incentive contract) or be subject to the penalties provided for in a default clause. There are various types of fixed-price contracts - firm fixed price (FFP), fixed price with economic adjustment (FPEA), fixed price incentive fee (FPIF), and fixed price incentive - successive targets (FPIS), to name a few. Under a cost reimbursement contract, the product is not paid for on the basis of an invoice price; rather the Government pays the contractor's cost for material and labor and a portion of his overhead cost in accordance with appropriate clauses in the contract. The principal cost-type contracts include cost, cost plus fixed fee (CPFF), cost plus incentive fee (CPIF), and cost plus award fee (CPAF).

Under a cost-type contract, the contractor agrees to use his best efforts to complete the contract within the estimated amount provided in the contract. However, he has no obligation when, despite his best efforts, the material or service contracted for is not fully provided at the time he expends the funds in the contract. The contracting officer may provide additional funds to defray the cost of completing the task(s) delineated in the contract.

Clearly the cost reimbursement contract has the potential for abuse if the contractor is permitted to spend the money without appropriate government controls. The PM must have the manpower resources at his disposal to effectively monitor contract performance. Despite this, the cost reimbursement contract is frequently used since in certain situations it is unrealistic to employ a fixed-price contract. A variety of factors (e.g., changing requirement, unforeseen technical problems) may affect the ultimate cost of completion. A contractor should be compensated for his allowable expenses, and it is both unfair and unproductive to throw 100% of the cost liability on the contractor when it is not possible to determine an accurate price at the outset of the contract.

The PM and contracting officer should carefully choose the type of contracts to be used in each phase of the acquisition process. Some members of the contracting community feel that during the Concept Exploration Phase, when the risk shared by the government and contractor is approximately equal and the actual end product has not been specifically defined, a cost-reimbursement contract such as CPFF is most suitable. Then, as the risk to the contractor diminishes and the product becomes better defined, the contract type can be shifted to CPAF or CPIF, and ultimately to a fixed-price contract (e.g., FPIF) during early production. The relative degree of risk assumed by the government and the contractor as a function of the type of contract is shown in Figure 4-7. (FPR is fixed-price redetermination).

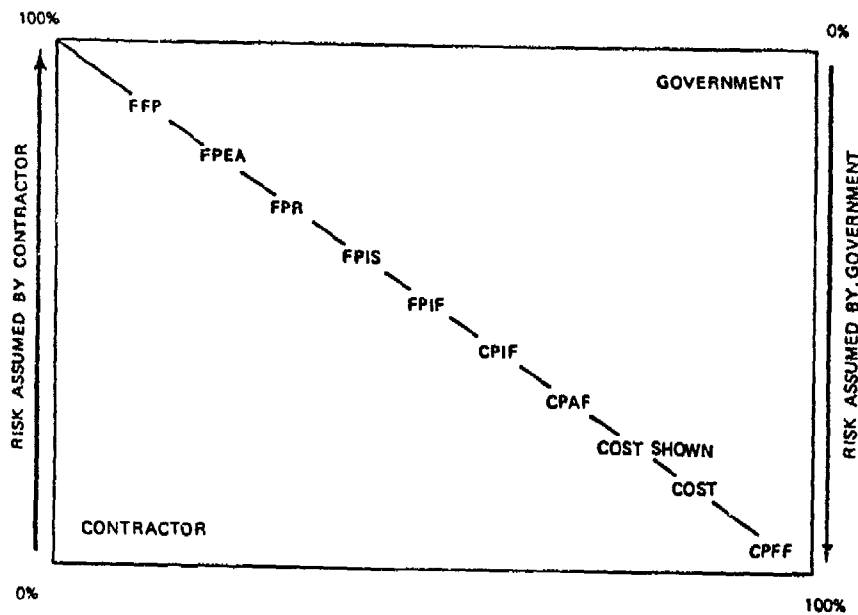


FIGURE 4-7. Degree of Risk as a Function of Contract Type.

The more generally held opinion, however, is that the fixed-price type of contract is appropriate for use during the Concept Exploration Phase because such a contract provides the only means of putting the contractors in a truly competitive posture. The products to be delivered under the Concept Exploration Phase contracts are quite clearly established. They are defined by the concept proposers themselves in response to a Request for Quotation (RFQ) featuring the defined operational need. The end product being contracted for is a proposal for, or a disclosure of, a proposed system to meet the defined operational need.

While the intent of the contracting effort during concept exploration is to maximize the competitive exploration of alternative concepts, the dollar amount of each contract should be sufficient to pay for the work requested. Contractors should not be expected to utilize their own funds to "buy in". The desire to explore as many concepts as possible must be tempered by the necessity of funding each exploratory effort at an adequate level. Parallel short-term contracts provide a means for compromising between the number of concepts to be explored and the level of funding for each. A large number of concepts can be funded initially and, by reducing the number of contractors remaining after each short-term segment, the total expenditure may be kept within the established limits.

Contract cost, although it is an important consideration, should not be the overriding consideration in this phase or in the Demonstration and Validation (D&V) Phase. The project's overall cost objective is the minimization of LCC. A bit more money spent in these early phases may reduce costs significantly in later, more expensive phases.

During the D&V Phase, the FFP contract may be the best choice. While the potential uncertainties are greater in this phase than the preceding one, and thus could conceivably warrant a cost reimbursement type of contract, if this phase is to be characterized by a continuing high level of competition, the contracts should continue to be of the fixed-price type. As in the previous phase, the dollar amounts of a contract in D&V Phase should represent the true cost of the work which the contractor proposes to perform, plus a reasonable profit, rather than a "buy in" value which relies upon substantial contractor investment which he hopes to recover later.

One of the varieties of the cost reimbursement contract should be used for the FSD Phase. The reason for this is that usually the actual cost to resolve the remaining technical uncertainties can only be estimated grossly at the outset of the phase. The government must have the flexibility to make the decisions required to achieve the best cost-performance-schedule compromises during the phase.

Use of the CPAF contract in the FSD Phase should be actively considered by the PM. In this type of contract, the fee is determined by a total evaluation of the product/system and contractor performance at pre-determined intervals in the course of the contract, or at contract completion. The CPIF contract, by contrast, has the fee determined according to a negotiated formula, and is considered a viable instrument whenever critical contract requirements can be quantified and contract performance against these requirements can be accurately measured. The CPFF contract is useful in situations in which the total cost of development at any given time is reasonably well known but changes in scope are anticipated. The CPFF is not recommended for the major equipment development contract.

It is possible that the pilot-production subphase of FSD could be more effectively executed under a fixed-price contract. The decision of whether to switch contract types should be made on the basis of maturity of system design and documentation and on the PM's judgment as to whether any "engineering changes" to the design (normally a way of life under any production contract) can be handled better in a fixed-price or cost-reimbursement environment. The PM should remember that the fixed-price type of contract at this juncture tends to inhibit that all-important stage in the design evolution process during which the design is accommodated to the production processes and procedures. Contracts for production for service use and service inventory should normally be FFP. The use of multi-year contracts should also be considered for those programs where it would provide significant cost savings.

The contract is one of the PM's essential tools. He should therefore build a strong justification for the type of contract he desires for the task at hand. As a rule, the contracting officer will tend to favor the fixed-price type contract because it is generally easier to administer than the cost-reimbursement type and, theoretically, places the cost liability on the contractor. The PM must bear in mind that the contracting officer operates within a framework of some 4,000 pages of regulations, clearances, approvals, etc. Changes in a contract require a great deal of time and effort on his part. Re-negotiating a cost-reimbursement type of contract is not a simple process, a fact that the

PM should take into consideration in determining the degree of projected-cost-curve slippage that will be permitted before he calls for renegotiation. In the final analysis it is the PM alone who has an overview of the entire program. It is he and not the contracting officer who will be most affected by program delays, cost overruns, contract litigation, and similar problems that arise from legally sound but tactically unwise contract decisions.

Contract Requirements Establishment

Procurement Request. The most vital document that supports the communication between the PM and the contracting officer is the procurement request. The purpose of the procurement request is to provide information that (1) describes the required supplies requirement or services clearly and completely so that the contracting officer may obtain acceptable offers for performance of the proposed procurement, and (2) supports any contractual recommendations it may contain (such as a proposal to limit sources). For example, the procurement request documentation serves as a basis for determining the method of procurement and for obtaining business and other clearances required by applicable regulations. The procurement request also becomes part of the permanent record of the procurement and thus it serves to support the government's position in any hearing or inquiry conducted in connection with its handling. Accordingly, the PM must ensure that the procurement request is carefully prepared and submitted to the contracting officer in a timely manner.

The documents defining the effort to be accomplished under the contract must be precise and complete. The contracting office will provide the best counsel for much of the input, including standard clauses and the like. The inputs will not be discussed here except to note that it is imperative to assure that appropriate technical members of the procurement team be afforded, by contract provision, ready access to the contractor's plant, personnel, in-process effort, and pertinent records. There are two areas in which it is essential that the technical side of the procurement team have the overriding input. These areas relate to the Statement of Work (SOW) and to data requirements.

Statement of Work (SOW). The SOW is used by the PM and his staff to define the non-specification work effort required from contractors and Naval support activities in support of the Navy programs. The SOW writers must be familiar with the policy concepts of NAVMATINST 4120.108 to ensure that they have taken every step toward (1) structuring their technical requirements to meet minimal needs, and (2) holding the cost drivers to minimal levels by tailoring referenced military specifications and military standards to the exactness of those needs and risk thresholds within the SOW. MIL-HDBK 245A (Navy) provides information necessary for the preparation of a SOW and should be carefully read by the preparer of the SOW and by the PM before reviewing the SOW.

After the contract has been awarded, the SOW becomes the standard for measuring the contractor's effectiveness. As the effort progresses, the Navy and the contractor will constantly refer to the SOW to define and clarify their responsibilities and obligations. When a question

arises concerning an apparent increase in the scope of non-specification work to be performed, the SOW is the governing document which must be used to resolve the matter. Language in the SOW defining the scope of limits of the contractor's effort is of critical importance at this time. If the SOW requirements are poorly stated, it will be difficult to determine if or when there has been an increase in scope, with the result that effective negotiations on cost and schedule will be impaired, if not impossible.

Data Requirements. A contract which requires any sort of data as a deliverable item must include a Contract Data Requirements List (CDRL), DD Form 1423. This list must state all data that the contractor is to deliver. This might include design drawings and specifications, test reports, manuals, analyses, status reports, cost/schedule reports and the like. For many of these items, a standard DOD-approved Data Item Description (DID) is available and must be used, with appropriate tailoring.

A balance has to be achieved between ensuring that the data required for administrative, statutory and programmatic needs are obtained and the elimination of unnecessary and redundant reports. The CDRL establishes a burden on both the contractor and the government. Data and reports cost money to obtain and prepare. Consideration of specific program/contract requirements should be considered in establishing the frequency, detail level, and distribution of reports. Contractual requirements for data must be identified in the CDRL. The SOW and provisions/clauses within the contract should not spell out data requirements that are not in the CDRL or it may result in data being produced and paid for without the PM'S knowledge or without any programmatic requirement. Such data requirements also open up the possibility of a dispute, since the contractor does not have to provide data not called out by the CDRL. Preparation of the CDRL needs the personal attention of the PM.

Source Solicitation

The PM will be guided by DODD 4105.62, NAVMATINST 4200.49, and his contracting officer for procedural direction in the formal, structured, source solicitation, and proposal evaluation process. The following paragraphs provide only background information oriented to the PM's role in the process. The simplest form of a Request for Proposal (RFP), although seldom used, is the requirement document and a cover letter.

A clear understanding should be reached between the respondents and the Navy with respect to the Navy's needs. Industry, Navy laboratories/centers, and other institutions should be encouraged to comment on and provide input to, a draft of the solicitation. These comments and inputs should be requested industry-wide and from all appropriate institutions. Requests should not be confined to one or two favored contractors.

The PM should be aware that it is "good" industry practice for a contractor to try to influence the solicitation so that it stresses his strengths. This should be resisted. The PM must, with appropriate

assistance and approval, establish policies and procedures that will make available to competitors the information developed by Navy laboratories and other support activities along with any other essential, government-owned information. Such policies and procedures should ensure that the competitors are free to propose solutions of their own devising, which may or may not use the government-developed solutions or approaches.

Solicitation

OMB Circular A-109 and Navy acquisition practice permit and encourage the use of a single solicitation for the entire acquisition process, from disclosures of alternative concepts through FSD and initial production. It is, however, frequently useful to issue a separate or supplementary solicitation for each phase effort at the time of or just prior to its initiation. These solicitations should request proposals near the end of each phase from all active contractors who are still in the competition. Negotiations concerning these proposals should be undertaken and carried forward while the contractors are still in competitive status.

The contracts awarded for the D&V Phase effort should include such output requirements as a complete set of proposed allocated baseline configuration specifications for the individually identified configuration items, and a proposal for the FSD Phase and initial production effort.

If the contractors' outputs during the Concept Exploration Phase did not contain sufficient detail to permit the preparation of a comprehensive Statement of Work (SOW), the PM may request additional material from the contractors. Evaluation criteria and an evaluation methodology can then be devised, and the data and documentation requirements and the tasks to be performed can be defined prior to the issuance of contracts. Some areas that should be specifically treated in the solicitation for the D&V Phase are discussed in the following paragraphs.

Use Environment. A system that will meet the Navy's need must be capable of being transported from the place of manufacture, in some cases stored, and ultimately performing in the use environment. This environment may include friendly and hostile electromagnetic radiation, countermeasures, maneuvers, friendly and enemy weapon systems, and adverse weather. Based on the mission profile (NAVMATINST 3000.1A) prepared during the Concept Exploration and D&V Phases, the PM should have an Environmental Design Criteria Document (EDCD) prepared and incorporated as part of the development specifications. He should also spell out what demonstrations are necessary to show that a contractor's concept has the potential for being developed into a system that will function effectively in the use environment.

Cost Estimating and Data Requirements. The cost estimating and data requirements called for in the solicitation should be carefully chosen by the PM. He should require the contractors' data and the

models that they used be made available to the Navy. This will assist the Navy in performing independent design-to-cost and LCC estimates of all the competitive systems, and trade-off studies of LCC, schedule, and performance. It may help prevent contractors from "buying-in": submitting optimistic and unrealistic cost estimates for full-scale development (FSD), production, and operation. The PM must recognize the implications of a "buy-in" and assume the lead role in preventing it or altering the acquisition strategy accordingly to allow the greater degree of control required. The PM should identify the government activity responsible for storing, retrieving, and processing the data and make this information known to the program organization and contractors (see DODI 7000.11 and NAVMAT Pub. No. 5241). However, only that data which is really needed should be required from the contractors as described in NAVMATINST 5000.15.

System Specification and Documentation Requirement. The system specification is used to state technical and mission requirements for the system, allocate requirements to functional areas, and define interfaces between functional areas. Requirements for the system specifications and other documentation must be set forth in detail in the solicitation and SOW.

The system specifications proposed by the contractors at the end of the Concept Exploration Phase will normally be the basis for the functional baseline configuration set out in the solicitation. The PM must ensure that the functional baseline configuration accurately reflects the needs of the Navy. However, it should be defined broadly, thus allowing the contractor the necessary latitude to use innovative technical and production approaches.

The system specification developed by each contractor during the D&V Phase will constitute the allocated baseline configuration of the system that he proposes to develop during the FSD Phase. This baseline establishes the performance thresholds which will be incorporated into the milestone review documents (MRD) and submitted for approval at Milestone II. Typical considerations that should be addressed are shown in Figure 4-8.

The proposals requested should include the proposed system specification for the allocated baseline configuration as well as the specification for performance, interfaces, and technical requirements of individually identified configuration items. If it is possible that production will be competed, the cost of proprietary and other data rights and cost of developing a Level III documentation package should also be included in the bid package while the maximum amount of competition prevails. Estimated procurement costs should be an important criteria for selection of the follow-on contractor. If possible, the competition for FSD should also result in production options with competitively determined ceiling price.

Competition

One of the most important considerations a PM will address is the

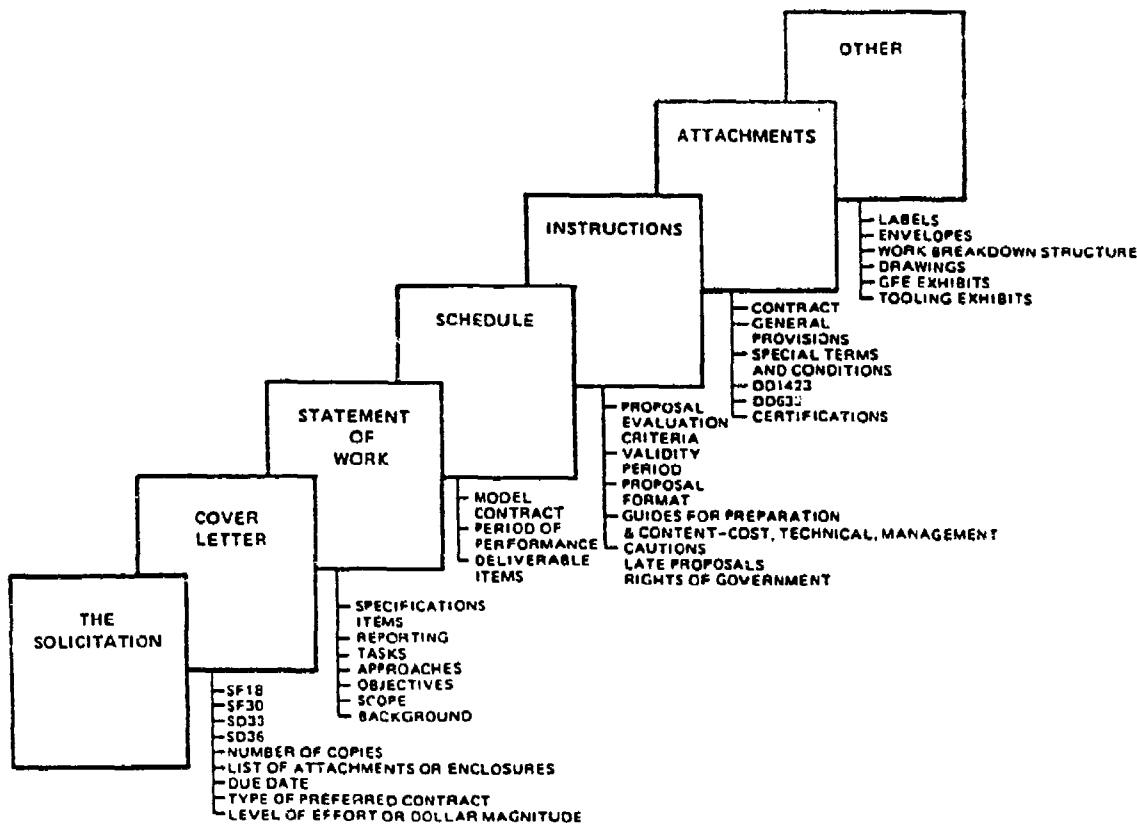


FIGURE 4-8. Solicitation Documentation.

task of "obtaining and sustaining competition". DODD 5000.1 states that "effective design and price competition for defense systems shall be obtained to the maximum practical extent to ensure that defense systems are cost-effective and responsive to mission needs." The basic concept of competition is simply that a competitive environment influences both individuals and organizations to excel. This concept is the very foundation for our free market economic system. The Competition in Contracting Act of 1984 (PL 98-369) as well as FAR 7.000 emphasize that full and open competition is considered standard; and that sole source procurements require full justification and authorization of the agency head. Competition will almost always be worth the money spent to generate it. There are two very substantial reasons to try and obtain the maximum degree of competition: (1) to develop the concept that best meets the mission need at lowest LCC and (2) to obtain that system at the lowest production costs. The first goal is achieved by competition in the Concept Exploration and D&V Phases and the latter goal in the FSD and Production Phases. The ground work for competition in production needs to be accomplished during the development phases.

In order to ensure that the Navy reaps the benefits of competition in new programs, procedures have been initiated by which each program is given an independent assessment as to the benefits of introducing competition at the time of its milestone review. In addition, the Navy has established the flag level position of Competition Advocate General (see Section 3) [MAT O9P and dual hatted under ASN(S&L)] with the objective of increasing competition in all types of procurement. Also Competition Advocates have been appointed at all Navy buying activities with procurement authority over \$25,000 and at many field activities which generate more than \$1 million in annual procurement requirements.

While a contractor may have a number of reasons for bidding on a program including entering new fields or maintaining a staff during "lean periods", the most compelling motivation of the contractor is to maximize profit. This is often in conflict with the PM's motivation to get the best system for the least money. Competition is far and away the best device the Government has at its disposal to ensure a reasonable balance between these two opposing ends.

During the Concept Exploration and D&V Phases, the thrust of competition is to conceive and clarify the concepts most likely to meet the mission need within the constraints of time, cost, and interfacing requirements. After these phases are completed; competition normally ceases unless more than one competitor is carried into FSD - a situation that rarely happens. More typically, the efforts of the winner of the D&V Phase competition are shifted to the development of the selected concept. Not until the system has been fully developed and approved for service use, and volume production for service use has been started, is it possible to reinstitute competition. The ground work for competition in production needs to be done during the development phases; it cannot be readily introduced as an afterthought.

A current Navy acquisition program, the Advanced Self-Protection Jammer (ASPJ), is using the interesting concept of tandem contractors during the FSD Phase. This program's acquisition strategy called for the pairing of contractors into teams, each team competing against the others. After progressive narrowing of the field during the first two phases, the winning team is jointly developing the system up to the commencement of the Production and Deployment Phase, when the contractors will submit competitive proposals for the first volume production buy. The winning contractor (the leader) will be awarded 70% of the first production buy and the other contractor (the follower), 30%, with an option reserved to the Government to reverse these percentages after competition for subsequent buys.

Competition during the production phase can have a startling effect on cost reduction. In one instance involving the guidance and control group of a guided missile, the development contractor proposed a unit production cost of \$20,000. This was judged to be unsatisfactory and the buy was opened to competition. The unit production cost immediately dropped to \$4,000. Even including the cost of establishing a production line at an alternative source, the projected savings for the inventory then visualized was on the order of \$200 million, much more than the entire cost of the development program. The PM whose program involves high volume production of the system or any of its parts should so

structure his acquisition strategy that competition during the Production and Deployment Phase is not precluded. The developing contractor may attempt to justify his use of all funds available for production (e.g., by planning large investments in production tooling). It is essential that the PM protect his funds and not permit the developing contractor to set up entry barriers for second-source production. DSMC has available a "Competition Handbook, Reestablishing Competitive Production Sources - August 1981".

Concept Exploration and D&V Phases. Within the limits of manageability, the PM should solicit inputs from the greatest possible number of qualified firms. Quality, rather than quantity, is the critical factor in this process and other should be concerted effort to identify and solicit those firms that have the highest likelihood of submitting viable concepts. After the best proposals have been selected for concept exploration, the inevitable narrowing of the field at Milestone I maintains a strong competitive atmosphere which will continue to motivate the contractors throughout the D&V Phase.

The PM should exercise care in determining the amount of funds to be allocated to each concept formulation contract. A few reasonably funded contracts will have greater value than many inadequately funded contracts for which contractor funding augmentation is required to produce a reasonable product.

Final Concept Exploration Phase reports by the competitors should include the information required for inclusion in the Milestone I review documentation, proposed statements of work, and proposals for conducting validation effort. ILS, production procedures, required system interfaces, system safety, human factors, and other areas related to the end use of the system concept should be addressed, although in-depth studies should not be expected at this time.

This should include criteria for D&V and identification of high risk areas. When areas of high technical risk become apparent, the use of appropriate in-house R&D laboratories/ centers to explore means, other than those taken by the contractor, for circumventing or minimizing such risks is encouraged. The PM may also want to consider the use of these facilities when he establishes procedures for the independent estimating of system LCC. The cost, schedule and performance estimates used to support Milestone I must be realistic to avoid large perturbations later at Milestone II.

The PM should attempt throughout these phases to acquire all necessary rights to the systems being developed, and he should prohibit contractors from incorporating proprietary items and processes into their systems. This will facilitate competitive procurement in the Production and Deployment Phase if such is desired. Another reason for seeking to acquire rights to the systems is that the system selected for FSD may benefit from a synthesis of technology from competing systems, although industry will typically deny the need for this synthesis, arguing that FSD should go to the "best" overall contract solution. The issue of whether, and how, to secure government ownership of proprietary material must be addressed by the PM prior to source selection. The provisions by which this ownership will be obtained must be clearly

defined in each contract.

FSD Phase. It is difficult to maintain competition as a driving force for contractor performance in the FSD Phase unless the acquisition strategy dictates that two competing concepts will be carried into FSD or the PM pursues an acquisition strategy similar to that followed in the ASPJ program noted above. More typically competition ceases at the conclusion of the D&V Phase, except possibly at the subsystem or component level. However, if successful competition for procurement or re-procurement is desired in the Production and Deployment Phase, early planning which is given substance and visibility in the acquisition strategy must be implemented in the FSD Phase. Successful competition demands that the product baseline configuration, as revealed by the specifications, drawings, and other documents, be carefully controlled and kept current and free of gimmicks that might render them incompatible with industrial firms other than the development contractor. The development contractor must not be permitted to develop designs that require special tooling setups available only to him, or to include his proprietary devices or processes that will not be made available to the general industrial community. Such practices can be averted if the PM and his technical team conduct in-process reviews of the documentation package as it develops and see that the Government takes physical custody and establishes configuration control at the time of release to pilot production or when formal technical evaluation (TECHEVAL) is initiated.

Production Competition Principals and Cost Considerations. OSD has established the following principals and cost considerations to be observed in assessing merits of production phase competition for major system (ACAT I) acquisition. They serve the as useful guidelines for all Navy acquisitions. They are as follows:

Production Competition Principals

- o There is a firm inventory requirement for the item sufficiently large to amortize facilities, tooling and qualification costs of multiple producers.
- o The requirement has an urgent or high enough priority so that funds will be programmed by the service and eventually appropriated by the Congress to buy the item in annual quantities that will yield economical production rates for two producers.
- o The cost benefit analysis clearly shows that substantial savings can be obtained through competition driving down the cost. The analysis should be conservative, e.g., show counter to savings of loss of learning due to split buy, and not project a premature competition buyout.
- o There is keen interest by capable competitive firms wanting to participate.
- o Proceeding with establishing the multiple sources will not be defeated by problems with proprietary information, acquiring re-procurement data or assumption of government configuration control.

- o Program time and resources are, or can be made available, to establish and qualify multiple sources and competition will be given sufficient program priority that such funds will not be diverted.
- o Industrial base considerations complement establishing multiple sources.
- o The competitive environment can be sustained given the programmed quantities and corresponding rates of production.
- o The operational and logistical needs of the mission can accommodate introduction of equipment from multiple sources.

Cost Considerations

- o Estimate net investment required to establish multiple source production capability.
- o Compare recurring costs from a single source versus costs from two or more contractors in competition.
- o Compare non-recurring costs in a single source environment versus a competitive environment.
- o Discount results (i.e., compare savings in outyears to upfront investment in present value terms)

Production and Deployment Phase. Competition should normally not be renewed until the production baseline configuration and the inspection and acceptance procedures have been fully evolved and demonstrated to be complete, stable, and in all other respects adequate to enable production at the desired rate by a commercial firm other than the development contractor. No disclosure to production should be considered to have achieved that condition until the three subphases of the FSD effort have been completed and volume production achieved by the development contractor himself in accordance with the production disclosure. However, occasionally, as with the Sparrow AIM 7F, competition was introduced prior to the production by the developer of a satisfactory reliable round. Indeed, one of the purposes of this competition was to improve system reliability and performance.

In the case of sophisticated guided weapons which must be produced in strict accordance with a detailed and rigorously controlled government design disclosure and performance specification, initiation of competition prior to initial volume production may cause severe disruption in the program time schedule and increase the probability of introducing inferior quality products into the service inventory. Such problems, once introduced, tend to persist and eventually jeopardize timely realization of a critical initial operational capability (IOC) and achievement of the project inventory objective as well. They may also lay the foundation for contractor claims and lengthy, costly litigation which the government seldom wins.

Even when competition is reintroduced at the proper time, it must be done prudently. Experience has repeatedly shown that the government's interests are best served when the PM takes the time and incurs the cost necessary to assure a demonstrated compatibility between any new source and the design disclosure before that source is allowed to manufacture articles for the service inventory. In cases where inventories are unacceptably low and assured deliveries of acceptable hardware are essential, the new source should be qualified before the active source is allowed to go inactive. This familiarization is best accomplished through the careful T&E of a limited quantity "familiarization" buy from the new contractor before a head-to-head, winner-take-all, share-the-buy, or leader-follower competition is undertaken.

The PM should realize that when the design drawings, processes, procedures, and other documents necessary for the transfer of the production of a sophisticated piece of hardware are duplicated and transferred from one contractor to another, there is probably more knowledge and understanding of how to produce the article that is left behind in the minds and hands of the active producer than is contained in the transferred material. Learning curves in production programs are not idle concepts. They are facts of production life and, as such, must be reckoned with.

Contractor Underbidding (Overoptimism)*

"At the outset of a program, our DOD bid process encourages substantial contractor overoptimism in technical accomplishment, in schedule, and in cost. The contractor environment is one of competition to win the support of the evaluators of the proposal; thus the contractor very much caters to the evaluator's interests. Most major requests for proposals are evaluated by service technologists who will not themselves have a role in implementing the program, which means they are not dominated by implementation interests. In fact, these technologists have little experience in cost control or production implementation and so frequently are not competent to judge implementation issues. They do, however, have a high interest in trying to exploit in operation the most taxing technology. The technologists can see only the merit of new techniques, not their difficulty - and they are the judges.

"In the main, the program office that is to execute the work is given the program only after the major characteristics of schedule, technical risk, and costs have been decided and cast in concrete. In practice, they cannot reject an unrealistic program. In fact, seldom does a program manager have a chance to really understand the quality of his going-in position before he is bound, contractually, to its execution.

* This section was extracted from an article by Dr. W. B. LaBerge (former industry vice president, Technical Director of a Navy R&D Center, Assistant Secretary of the Air Force for R&D, and Under Secretary of Army) that appeared in Concepts (Vol. 5, No. 1, Winter 1982) published by the DSMC. The article is entitled "Defense Acquisition: A Game of Liar's Dice".

"The contractor proposal is most usually the basis for all execution planning, even though 'promising the moon' is known to be the key to successful contract award. Proposal writing in the last few years has become Liar's Dice in its ultimate embodiment. There is no disincentive to writing a barely credible proposal that can match the disincentive to writing a conservative proposal; namely, the loss of the award.

"Not only does DOD provide no disincentive to the low-balling of bids, it further hurts itself by not including in its long-term estimates the cost reserves necessary to compensate for the unrealistic bids.

"The Fallacy of Fixed Price. To further complicate matters, there is the erroneous belief on the part of the acquisition community that R&D procurement with fixed-price initial production options helps improve cost credibility. Nothing could be further from the truth. If anything, it hurts cost realism. These fixed-price procurements do nothing to obtain better bids, but do much to deny the government the cost information that is much more available to it in a cost-reimbursement environment.

"A contractor today is asked to bid fixed-price in competition with another vendor on development and up to 10% of the expected long-term production. Each contractor knows that if he can win the first competitive bid, he will be facilitated by the government or assured of a contract that will allow him write-off facilitization, that he will have a labor base to absorb his fixed overhead, that he will be able to absorb company-sponsored future development work, and that he can eventually make a profit. He knows that if he loses he will be unable to do any of these things. In fact, without a new labor base, he may spoil the profitability of his present contracts. The contractor also knows that he is reasonably safe from punitive action. He knows that the Federal Acquisition Regulations System (FARS) assure him that he will be paid real costs and a fair fee for the remaining 90% of the production, which by then will no longer be in competition. He also knows that in today's application of the FARS his fee on the non-competitive 90% is not determined by the dimensions of the exaggerations he may have told to get the job in the first place.

"In light of all these considerations, today's contractor inevitably explores how low he can bid on the competitive 10% and still make out on the fees, overhead, G&A, and benefits of the non-competitive 90%.

"The only real disincentive to a low-balling bid is the possibility of problems with cash flow on a gross underbid. But good, strong companies (and many others not so strong) are willing in this kind of competition to risk quite a cash flow hit if the benefits can be expected to be great enough. This situation is quite unrealized by DOD today.

"Proposals to Prevent Contractor Underbidding (Overoptimism). Make as a condition of all bids down-selecting to a single production contractor that fee and G&A recovery for the entire contract will be scaled to how well downstream production costs correspond to the estimates

made at the time of down-selection.

"Make as a condition of contracts leading to production that full amortization of production tooling investment be guaranteed or that the tooling will, if desired, be bought back by the government. In either case, the contractor must be compensated fully in this facilitization for out-of-pocket costs including costs of money.

"Provide the professional manpower to institute an obligatory government 'should cost' process that does not allow (except by service system command approval) award of production contracts whose costs vary more than 10% from government estimate.

"Ensure that the team that evaluates proposals for a program has the responsibility for executing that program. Do not let the off-line technologists determine the contractual commitments.

"These four suggestions, in sum, attempt to make it much more profitable for the vendor and his competition to bid realistically than to play Liar's Dice in his proposal."

Proposal Evaluation

Proposals in response to the RFP will be evaluated by the PM in accordance with the approved source solicitation plan. Navy in-house facilities can be the PM's greatest aid in the proposal evaluation process, though care should be taken to ensure that an in-house proposer of a concept is not also involved in the evaluation process.

Evaluation criteria should be flexible enough to be applied to the most diverse alternative concepts and yet they must be sufficiently structured to permit equitable application to all proposals. A partial list of critical factors that must be addressed includes: the effectiveness of the proposed concept in meeting mission need; the total LCC (and here the contractor's estimates should be verified by independent estimates); manning and training requirements; the support constraints, including the minimum acceptable values for reliability, maintainability, goals for operability and transportability, and safety requirements; and the track record of competitors, including their management structure and the competence of their key personnel. Where possible, evaluation criteria should be quantified. Separate evaluation teams (e.g., cost team, technical design team, production team, management team, ILS team) will normally be required to properly evaluate proposals.

Figure 4-9 illustrates one approach to structuring and weighting evaluation criteria. The numbers above the boxes, totaling 100, represent the weighting factors. Weightings of the individual criteria should include the desired value as the mid-point, the maximum desired capability as the goal, and the minimum acceptable level of performance as the threshold. In establishing each criterion, the PM should take into consideration the probability of failure to meet or exceed the agreed upon standard for measurement and the consequence of such failure.

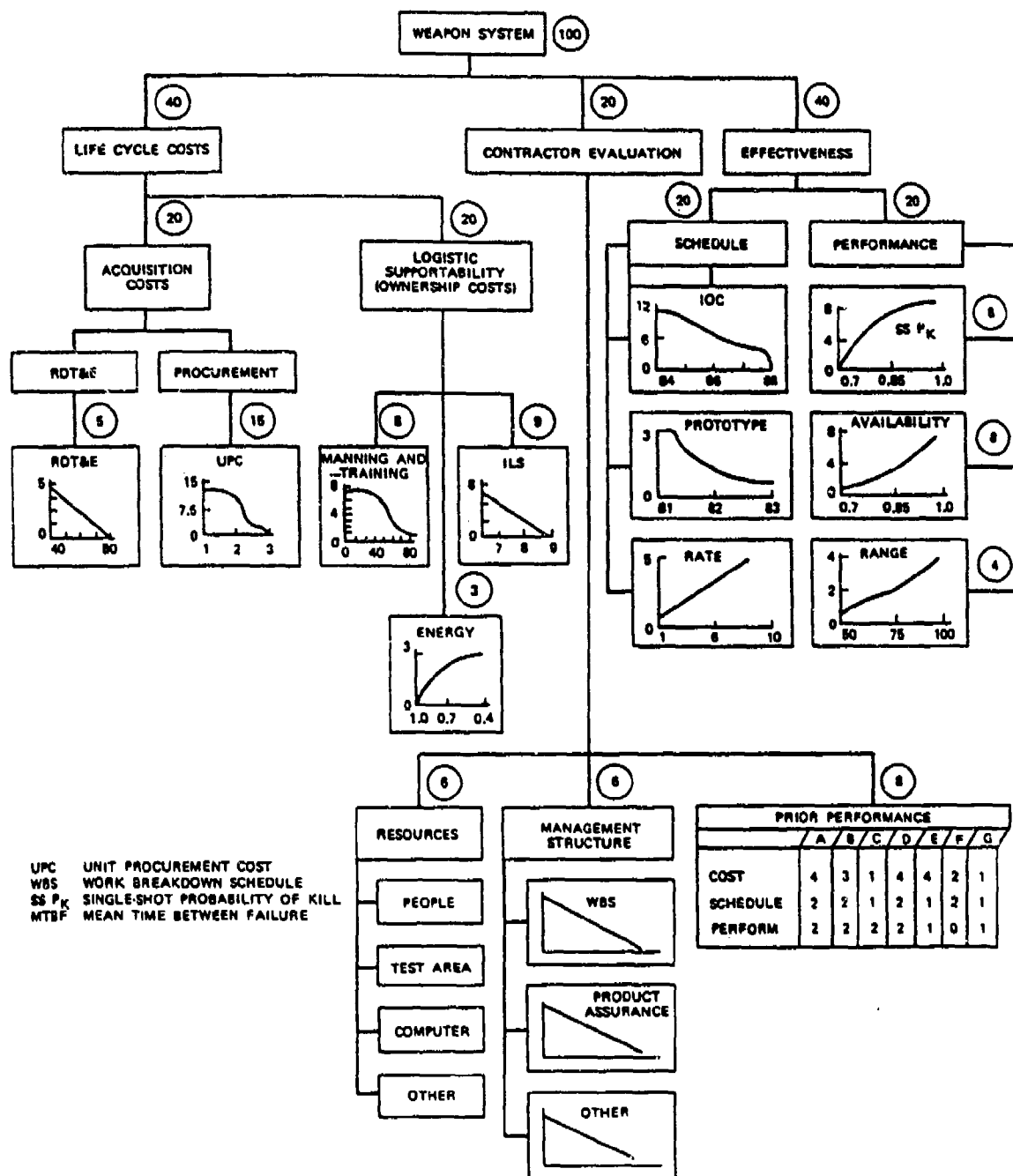


FIGURE 4-9. Structuring and Weighting Evaluation Criteria.

The lowest price is not always the best offer. The PM should review the contractor's assumptions and conditions versus the "request for proposal" requirements. Also, the contractor facilities and resources should be reviewed to ensure he can do the job. Post-award-contract conferences should be conducted to ensure that contractors fully understand contractual requirements and that the government is clear on what the contractor intends to do and how he intends to do it.

Source Selection

Selecting the proper sources with which to contract for the program's needs can be one of the PM's most critical tasks. An unqualified or unreliable source will jeopardize the success of the program regardless of how well the contracts are drawn or how efficient the procurement team is. The Federal Acquisition Regulation System (FARS) requires that the R&D contracts be awarded to those organizations "...which have the highest competence in the specific fields of science or technology involved." The PM must determine the contractors' "...understanding of the program and the ability to organize and perform the contract." The disciplines governing the selection of contractual sources for major defense systems are contained in DODD 4105.62 and amplified in NAVMAT-INST 4200.49.

Source selections for the development of complex, high-technology major systems will normally employ a two-stage evaluation process. The second of these - the evaluation of responses to the full solicitation - entails so much time, effort and expense that to keep the task manageable, a relatively superficial, first-stage, preliminary screening is often needed. The first-stage evaluation is intended to eliminate those candidates who, in the judgment of the evaluation team, have the least capability of proposing and developing a concept suited to the mission need.

A large number of firms respond with expressions of interest to the synopsis of the contractual effort published in the Department of Commerce publication, Commerce Business Daily (CBD). However, before the solicitation is issued to a firm, that firm must be judged to be technically and industrially qualified to participate effectively in the acquisition process.

RFPs are issued to the firm chosen from among the CBD respondents. Respondents may also be required to post a nominal, refundable bond as an indication of their serious intent and as a means of eliminating the merely curious. A bidder's conference may be held after the solicitation is released, wherein the selected firms are provided with the RFP and related documents and given an opportunity to ask questions of the government team in attendance. The bidders are apprised of any known or anticipated problem areas and any solution or approaches deemed by the Navy to be worthy of consideration, and are provided with any other information which might be helpful in the development of a response to the solicitation.

The evaluation team is usually composed of several individuals or

groups. These individuals or groups represent areas of expertise essential to an in-depth and equitable evaluation of the competitor's responses. The evaluation team must apply established criteria to determine how capable each contractor is of developing his concept to successfully meet the mission need within the given constraints of time, money, and available technology. The evaluation criteria applied to the solicitation will be framed, as far as possible, in quantifiable parameters to facilitate comparison of the solicitation respondents. The PM may find it important to have individual areas evaluated only by the team members expert in those fields. This avoids a dilution of expertise and an over-democratization of the selection process.

The evaluation criteria will typically include (but not be limited to), technical capability, production capability, past experience, management, the proposed technical approach or concept, reliability and maintainability, design and manufacturing fundamentals, estimated cost of concept development, and estimated LCC. Great care must be taken in selecting the evaluation criteria and their weighing factors to ensure that gradations in scores will be produced and that these will be indicative of the anticipated performance (See Figure 4-8, also "Risk Management" later in this section).

In evaluating the contractor's personnel, it should be kept in mind that each contractor has a strong interest in "putting his best foot forward". It is therefore quite possible that an extremely competent technical team, which rates highly with the evaluators, may not remain together throughout the program and may even see significant personnel shifts shortly after the contract is let. Legally, there is nothing wrong with this. However, the government should be able to expect that the replacement team would exhibit a comparable capability; and should insist that it do so. If key contractor personnel are critical to the success of the program, a list of these individuals can be incorporated into the contract. Any change of key personnel thus entails a change in the contract itself and requires government approval or re-negotiation. The evaluators should look not just at the qualifications of key personnel, but at the level of expertise represented by the contractor's entire technical team. The PM must ensure that the Source Selection Evaluation Board (SSEB) makes a thorough and unbiased evaluation of the proposals and that the factual information necessary for that evaluation is expeditiously provided.

A final word about the effect of cost on the source selection process. The estimated cost of the Contractor's proposal will certainly be a factor in the evaluation process. Cost is a driving factor throughout the system acquisition process, but it must be put in perspective with other driving elements. In the development stage, the prime concern is to find and engage contractors who have the conceptual ideas, manpower, management expertise, facilities, and the demonstrated experience to develop a system capable of meeting the mission need. Cost estimates in the earlier stages of the acquisition process are far from precise, and independent estimates of development and LCC by an in-house activity are needed to establish a baseline against which to evaluate the validity of contractor cost estimates. With due regard for its significance, cost is a controllable element which can be managed

through carefully drawn, properly executed contracts and through liberal use of competition throughout the acquisition process. The cost to develop a system is only one part, albeit an important one, of the system LCC. Costs incurred in development can return large dividends in the form of lower production and maintenance costs as well as in improved performance.

Contract Award

The PM must understand the contracting process and work with the business manager, technical manager, and the contracting officer to develop the most appropriate contracts. The technical manager and contracting officer may approach a contract from opposite directions. The technical manager's interest is normally in a contract that provides him some control over the work. He wants to get the best technical effort and to this end may see the desirability of some technical transference to improve the end product. The contracting officer may be more concerned about the legal aspects of a contract and he will usually be disposed toward obtaining a contract that facilitates award and administration. The PM and his business manager must try to obtain a contract that reconciles the interest of both the technical manager and contracting officer and satisfies the need of the program for the particular phase.

Contract negotiations should be conducted while the maximum competition exists prior to selection of the most promising candidates.

Evaluate contractors' claims to proprietary rights in data. Encourage the negotiation or agreements by which unrestricted or royalty-free use of data will be available.

Re-evaluate contractors' claims to proprietary rights in data. Encourage the negotiation or agreements by which unrestricted or royalty-free use of data will be available.

This continuation of effort is based upon the need to keep the selected contractor teams intact and in a position to carry on the effort when the milestone decision is rendered.

The PM must rely heavily on his contracting officer during the contract proceedings. One of the duties of the PM is "ensuring communications, actions, or inactions in any form that might be interpreted as directional to a contractor shall be conducted through or with the concurrence of the designated contracting officer." (SECNAVINST 5000.1.)

Contract Technical Management

Government management of FFP contracts must be minimal. Indeed, since the contractor has agreed to provide a specific product on a given schedule for a predetermined price, any attempt by the government to exert undue management pressure, other than that inherent in government monitoring of progress and cost, could be construed by the contractor as

a change to the contract with a concomitant change (increase) in price. For a cost reimbursement type contract, on the other hand, the product may not be specified so precisely and schedules and costs are "goals" rather than commitments. This means that a series of significant cost-performance-schedule trade-offs will normally be made over the course of the contract. The decisions involved in these trade-offs are the responsibility of the government (the PM). They cannot be surrendered totally to the contractor. Even where the trade-off decisions are well within contract bounds, the PM - or some Government representative assigned responsibility for monitoring the contract - must be aware of these decisions as they are made to assure that interfaces with other portions of the program are not affected, and that cumulative effects of this and other decisions are within acceptable limits. Also, it is imperative that any problems or incipient problems relating to the contract effort be identified by or to the PM at the earliest possible time. Obviously, management oversight of the contract is required to achieve these objectives.

Contract Monitoring. The actual process used to maintain a current awareness of contract progress and problems will vary from PM to PM, but, in general, it will consist of some combination of formal written reports, review meetings, and informal discussion, observation, or inspection of contractor efforts by representatives of the PM.

Close monitoring of the ongoing contracts by competent technical and managerial personnel is essential. Briefings by the contractors at regular periods or milestones will be necessary and, similarly, new threat or operational task data should be made available by the Navy to all contractors. The PM may employ Navy laboratories/ centers and field activities during this period to identify potential technical problems and work toward their solution. Work may be initiated to develop government-owned alternatives to proprietary processes incorporated in concepts proposed by industrial competitors.

Formal Reporting - Cost Schedule Control System (CSCS). The basis for any formal reporting process should be the contractor's CSCS. DOD requirements and criteria for such systems are established in DODI 7000.10. Implementation guidance is provided in NAVMAT Pamphlet P5240 for major programs and in NAVMAT Pamphlet 5244 for less-than-major programs. Several points bear emphasis:

The contract WBS is the framework within which any of these system developments takes place. It is important that the PM assure that the WBS and the levels to which it is extended are compatible with the degree of control desired.

Special attention should be paid to the contractor's analysis of any variances between planned progress and actual progress. Since such analyses involve "engineering judgment", it is imperative that technically competent government personnel assess them independently to assure that the information provided the PM is as realistic and timely as possible. Personnel from the Navy laboratories are well suited to participate in such assessments, particularly if they are involved in the technical monitoring function discussed below.

Care must be taken to assure the contract requirements include the necessary reports. This is done by inserting the proper entry in the CDRL, DD Form 1423. Standard DOD Data Item Descriptions are to be used for this purpose. The reporting requirements must be appropriate to the contract effort, and the PMO must exert every effort to assure that the contractor submits complete, accurate reports on time.

Status Review. Status review can vary from quite formal reviews involving many people (contractor and, possibly, subcontractor management and technical personnel, the PM and other government management and technical personnel) covering the total program to relatively informal reviews involving fewer persons and covering only a segment of the contract effort. These reviews, particularly the larger ones, should be held on a periodic basis, probably no more often than quarterly. Provisions should be made, however, for convening special sessions in instances where problems appear to be emerging. Adequate provisions for these reviews should be included in the contract. Also, the PM must assure that the government team includes specialists with the requisite knowledge to ask the right questions and to assess the validity and implications of the answers. He must also assure that there is a procedure for guaranteeing that any action items arising from these meetings are addressed and completed in a timely and adequate manner.

Should-Cost. Should-Cost is a concept of contract pricing that employs an integrated team of Government procurement, contract administration, audit and engineering representatives to conduct a coordinated in-depth cost analysis at the contractor's plant. The purpose is to identify uneconomical and inefficient practices in the contractor's management and operations and to quantify the findings in terms of their impact on cost, and to develop a realistic price objective which reflects reasonably achievable economies and efficiencies.

A Should-Cost review is made in connection with the procurement of all DOD major systems (ACAT Is) unless the contracting officer makes a written determination that the potential savings to be realized do not justify the expense of such a review. Should-Cost reviews should also be considered in procurement when: there are future year procurement requirements for substantial quantities of like items; there has already been some initial production; the competitive forces are insufficient to ensure economical and efficient performance (e.g., sole source); and/or the specification is comparatively definitive but is not likely that the product to be produced will meet the specification.

In-Plant Technical Monitoring. This aspect of contract monitoring is frequently the most effective means of identifying incipient problems early, or providing assistance in determining solutions to such problems, and of assessing the validity or probability of success of proposed solutions. The important thing is to assure that the government representative is technically competent and that contract provisions afford the representative complete access to the contractor's plant, personnel, and effort related to the contract. While it may seem reasonable to assign this function to the contract administrator at the contractor's plant, he is normally not geared to accept that responsibility (although he may not always recognize this to be true). Monitoring a contract may involve one or several engineers in full-time resi-

dence at the contractor's plant, or it may involve one or several engineers making periodic visits to the plant. In any case, it is imperative that some sort of memorandum of understanding between the PM and the local contract administration representative be developed at the outset to define area of responsibility and interfaces between the program manager's technical monitors and the contract administration organization.

Work Assignments. Under certain circumstances, it may be necessary for the PM to exercise more positive control over the progress and scope of the contract effort. One method of doing this is through the use of work assignments. A work assignment is a part of the contract and represents an amplification or detailing of the contract work statement for some finite portion of the effort. It is, in essence, a mini-contract with its own schedule, budget, and product(s). Effort under a work assignment can be started only after the work assignment is issued by the contracting officer and is accepted by the contractor. Indeed, under such a contract, no effort can begin until at least one work assignment is issued. The use of a delivery-order-type contract does impose a greater burden on the technical administrator of the contract and on the contracting officer; however, it may provide the essential control required in instances where time-phasing of the effort of several program participants is critical, where sensitive technical decision points are anticipated, or where the contractor has a reputation for inadequate control over his efforts or those of his subcontractors. If this procedure is to be used, it must be provided for in the contract and each work assignment must be carefully defined and issued in a timely manner.

RISK MANAGEMENT

The correct estimation of risk and its effective management are essential elements of program management and have received increasing emphasis under the DOD acquisition improvement program. DODD 5000.1, for example, requires that the overall acquisition strategy, including a selection of which development phases are and which are not necessary, must be tailored to minimize acquisition time and cost consistent with the degree of technical risk (emphasis added). Congress, too, has expressed its members concern with the risks associated with weapon system acquisitions, especially those risks that impact FSD and production costs and schedules.

Risk management is the process of identifying areas of risk that can affect the successful development of a system, and taking corrective action to reduce the risk to an acceptable level. As used in this discussion, risk is a function of both the probability and the consequence of failure. In many respects, risk management epitomizes effective program management - systematic reduction of risk in the evolution of a system acquisition. The methodologies of risk management are applicable to a number of PM duties, from overall system planning to the evaluation of proposals and selection of contractors, and from the development of management options to the detailed technical development of the system being acquired and as a means to offset the effects of cost during the R&D phase of a weapon-system life cycle.

There are many ways to evaluate and manage the risk connected with a program; the ones used should be appropriate to the program's size, complexity, and stage in the acquisition process. Risk analysis is especially important with respect to large acquisitions with many component elements (such as a missile with guidance, control, propulsion, warhead, and initial spares) and to major operation and support elements such as depot and below-depot maintenance. In the very early stages of a system's development, when uncertainty and hence risk is greatest, it should at least be possible to bound a "most likely" estimate with a high and low variant. The high and low estimates should preferably reflect actual/experience with either systems or subsystems, or be based on the outcome of certain events or policy decisions, rather than being arbitrary percentage increases and decreases to the original estimate. Figure 4-10 provides one guideline for qualitatively identifying the level of risk associated with a new program.

As the system proceeds further into the acquisition process, more quantitative treatment of risk should be possible. The specific methodologies for quantitatively estimating risk are usually mathematical in nature: probability theory, Bayes' theorem, linear programming, etc. If the PM is not familiar with these methodologies and the related management systems and network models such as Critical Path Method (CPM), PERT, Venture Evaluation and Review Technique (VERT), TRACE concept, and MARK III, he should obtain expert assistance from inhouse Navy or other specialized consultants. This assistance should be obtained before a prime contractor is chosen, since one of the most effective applications of risk management methodologies is in the development of quantitative evaluation criteria for selecting alternative concepts during the Concept Exploration Phase.

| TYPE OF RISK | LEVEL OF RISK | | |
|----------------|--|---|---|
| | LOW | MODERATE | HIGH |
| ADMINISTRATIVE | PROGRAM IS REQUIRED. ACTIVITY IS ONGOING. | REQUIRED ACTIVITY IS MODERATE IN COST AND NONCONTROVERSIAL | REQUIRED ACTIVITY HAS MODERATE-TO-HIGH COST AND IS POTENTIALLY CONTROVERSIAL |
| DESIGN | SIMILAR TO PAST DESIGNS; CRITICAL PARAMETERS CAN BE ESTIMATED WITH CONFIDENCE; MANY DESIGN OPTIONS AVAILABLE | MODERATE EXTENSION FROM PAST DESIGNS AND THE ESTIMATED RANGE OF CRITICAL PARAMETERS IS ACCEPTABLE TO VEHICLE DESIGN; LIMITED NUMBER OF DESIGN OPTIONS AVAILABLE | SIGNIFICANT EXTENSION FROM PAST DESIGNS; ESTIMATED RANGE OF CRITICAL PARAMETERS CAUSES SIGNIFICANT CONCERN IN THE FINAL VEHICLE DESIGN; ONLY ONE OR TWO DESIGN OPTIONS AVAILABLE |
| DEVELOPMENT | MINIMAL STATE-OF-THE-ART EXTENSION; SEVERAL FEASIBLE APPROACHES DEFINED; R&D UNDERWAY AND SUCCESSFULLY MEETING CRITICAL MILESTONES | MODERATE-TO-SIGNIFICANT EXTENSION; FEASIBLE APPROACHES DEFINED BUT CURRENT R&D NOT SPECIFICALLY ORIENTED TOWARD THE REQUIRED TECHNOLOGY DEVELOPMENTS NECESSARY FOR THE VEHICLE DESIGN | SIGNIFICANT DEVELOPMENT REQUIRED TO EXTEND THE STATE-OF-THE-ART; FEASIBLE APPROACHES HAVE BEEN DEFINED BUT LACK SUPPORTING EXPERIMENTAL EVIDENCE THAT THE APPROACH WILL BE SUCCESSFUL |

FIGURE 4-10. Preliminary Estimate of Program Risk.

Multi-Attribute Utility Model

Making decisions with incomplete information is the essence of risk management. Use of the limited information available can be optimized through a five-step process based on the relatively simple multi-attribute utility method. The five-step process consists of:

1. Breaking down the tasks to be accomplished into manageable components or attributes.
2. Estimating the utility factor, the relative importance of each component or attribute.
3. Developing a utility function or curve which describes the utility values as a function of some descriptive variable (i.e., reliability in terms of mean time between failure).
4. Estimating the risks associated with attaining the utility values chosen for each attribute.
5. Developing options to avoid or overcome obstacles to success and to compare alternative paths, solutions, or concepts.

The first step of the process requires breaking down the program into manageable components, since the estimation (and correction) of risks associated with any large task is generally unmanageable in the aggregate. A WBS taken to the third or fourth level maybe useful. The level of detail reached must be sufficient to allow a meaningful estimation of the element of risk that is associated with each lowest level component or system attribute.

The second step in the process calls for the assignment of a utility factor to each attribute. The utility factor represents the relative importance of the specific attribute to the overall program; for example, how important is survivability to the program as compared to range or speed? The sum of the utilities assigned to the lowest level attributes must equal the next higher level until the total value for the system, usually set at some arbitrary value such as 100, or 1000 is achieved. Each attribute should be considered individually by the PM and his technical advisors. Their collective experience, expertise, and intuition should be applied to estimating the importance of a particular attribute to the overall system and the consequence of failure to meet the system goals that the attribute represents and to identifying likely problems and their probability.

Having laid out the hierarchy of attributes and their relative weights, the third step is to further describe each of the lowest level attributes by designing or using a variable which describes it. As an example, in Figure 4-11 the attribute "System Sensitivity" is described by the non-dimensional term, "Figure of Merit (FOM)", and by consulting with his technical experts, the PM has determined that a minimal acceptable value of 150 would be usable, a target value of 200 is desired, and that a value for the FOM of 300 would have even greater utility if it were attainable at reasonable cost (subject to other tradeoffs). However, FOM values greater than 300 are probably not attainable, nor

would they provide greater system utility without making significant impacts on the rest of the system. Thus a range has been established over which various alternative concepts will be considered for such an antisubmarine warfare (ASW) system. The utility of each of these values must also be decided on by the PM and his staff and a utility curve generated to connect the assigned utility points to be chosen values of the variable. One possible utility curve is depicted in Figure 4-11(c).

Some type of utility function should be attempted for each lowest level attribute. Notice, however, that some attributes do not lend themselves to quantification, or at least do not lend themselves to credible quantification. For example, crew morale resulting from improved use environment is an attribute that cannot or should not be quantified. That does not mean that it should not be identified as an attribute of importance in comparing alternative ASW concepts. It is just that any attempt to quantify it would not aid in the analysis process, and might actually hinder it.

What has been developed after three steps is a hierarchical matrix, weights assigned to the various attributes and subattributes of the matrix and, where possible, utility functions for each of the lowest level attributes. Next, various alternative concepts, designs or schedules which might be submitted or used are scored through use of the matrix to help decide which are best. For example, assume that some particular system concepts have been proposed for consideration. Assessments must be made as to each concept's area coverage, sensitivity, LCC, fuel consumption, manning levels, skill, specialized training required, and so forth. These assessments can take the form of point estimates or of probability distribution, as indicated in Figure 4-11(d). Once these assessments have been made, the various concepts can be scored to aid in the process of deciding upon the optimum system.

Techniques for performing the first four steps can be generalized (see Figure 4-11), and significant progress in risk management can be made by effectively accomplishing these steps.

Effective accomplishment of the fifth step of the risk management process will depend upon the talents of the PM, his subordinates, and contractors, and the ingenuity that they can bring to bear on specific problems. This step may involve accepting an increased risk for one of several attributes so as to be able to reduce risk in areas where the payoff will be greater, or even to assume greater overall risk if the potential benefits significantly outweigh the possible consequences of failure.

As an adjunct to the five-step risk management process, it is useful to construct time and contingency fund hedges and to assign monitors who will bring likely problems to the PM's attention in a timely manner. The more potential problems that can be isolated in this manner, the better equipped the PM will be to deal with them should they develop. It has been accurately observed that "it isn't the known unknowns that will get you, it is the unknown knowns".

The five-step methodology outlined here must be viewed as a decision-aiding, not a decision-making device. This applies to all risk

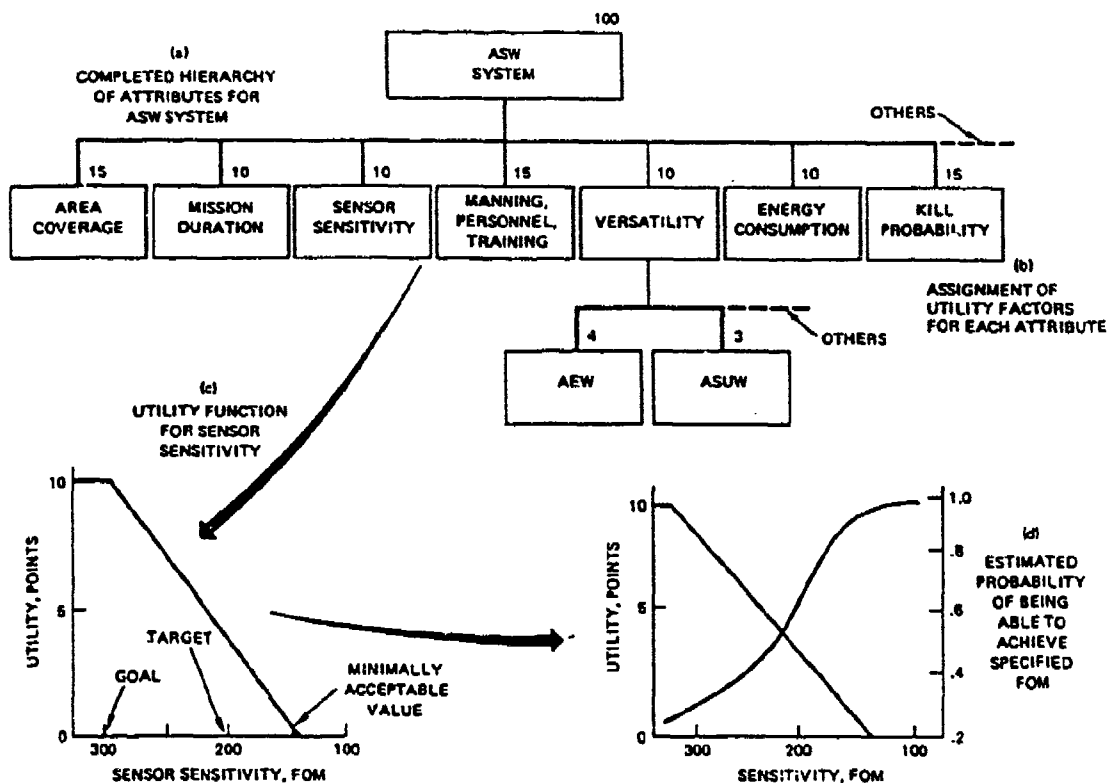


FIGURE 4-11. Risk Management Evaluation Process.

management methodologies. It is very tempting, especially for practitioners of a particular methodology, to view the procedures involved as a replacement for management judgment. The methodology only provides a mechanism whereby proposed changes or alternative concepts can be evaluated. When a change or choice is suggested, its ramifications can be assessed according to the attributes, weights, and utility functions in order to determine whether it causes a net gain or loss. The main advantage of this approach is the degree to which the communications process is facilitated and enhanced. The explicitness of the matrix of attributes, the weights, the utility functions, and the assessed probability distributions tend to make the process self-correcting. The second advantage is the achievement of a much greater degree of objectivity in the risk analysis and assessment processes than might otherwise be expected. When opinions are displayed and critiqued, narrow-minded orientations give way to a more balanced outlook.

Budgeting for Program Risk

Until recently, PMs who requested funds specifically to cover program uncertainties usually found those funds deleted by the DON, DOD, OMB, or Congress. As a result, PMs either budgeted an undisclosed management reserve (typically spread in small amounts across the program

tasks or concentrated in an expendable element that could be cut without affecting the program) or suffered cost and schedule overruns when unprogrammed and unbudgeted events occurred. Improper budgeting or inevitable overruns are no longer the extent of the PM's options. Action in Deputy Secretary of Defense (DEPSECDEF) Carlucci's initiatives to improve the acquisition process calls for the services to quantify risk associated with an acquisition and to expand the use of budgeted funds to deal with the uncertainty.

The Navy has responded to this directive by requiring that each PM include risk assessment and the means for dealing with it in his acquisition strategy, and that he include within the acquisition strategy a financial strategy describing realistic funding necessary to achieve the acquisition objective. By Milestone II, it must be shown that the technical and operation risks have been reduced to acceptable levels.

Total Risk Assessing Cost Estimate (TRACE) Concept. The Navy is evaluating the use of the TRACE concept, developed by the Army, as a means for budgeting for risk. TRACE is designed to aid the PM in estimating the costs associated with program risks and providing a means for budgeting sufficient funds to react to these risks. The TRACE process begins with a PM's baseline cost estimate (BCE). The BCE, which is the PM's comprehensive evaluation of the estimated LCC for the program, is generated by standard estimating procedures and includes R&D, investment, operational, and logistics-support costs. The R&D phases are then re-examined for identifiable risk areas, e.g., technical design changes to correct deficiencies, re-scheduling around technical problems, additional testing to verify design corrections, additional hardware to support design modifications, schedule slippages caused by late deliveries, non-negligent human error, etc. Costs to the program for changes in requirements, inflation, and pay increases are not to be included in the TRACE. The identified risk areas are then incorporated into the PM's estimating methodology and a new estimate for the R&D phase, the TRACE, is made. The TRACE allows for a 50-50 chance of producing either a cost overrun or cost underrun. This additional amount of money is then held as a risk or TRACE funding deferral. At least four different means have been developed and used for obtaining the TRACE. Only two are discussed here: the risk-factor method and the probabilistic-network-modeling method.

The risk factor method involves breaking the R&D phase activities down into sub-elements using WBS defined in MIL-STD 881A and discussed earlier in this section. The cost for the R&D is computed by totaling the costs associated with each sub-element level to form the BCE. The risk inherent in each sub-element is subjectively determined, in a manner similar to that described in the discussion on the multi-attribute utility model, and an additional cost for that risk estimated. The TRACE estimate for the sub-element is simply the BCE plus the cost to cover risk. The total TRACE for the R&D phases is generated by aggregating the sub-element TRACES. In most cases, the TRACE is then divided into budget years and the risk deferral for each year is separately funded.

The probabilistic-network-modeling method is basically a combination of general program evaluation and review techniques such as PERT

and Monte Carlo simulation. Cost and schedule uncertainties are incorporated (as in the risk factor method) into the model, which is then exercised in successive computer simulation runs. The output provides a distribution of the estimated program costs and schedule.

The value of the TRACE concept in program management is that it provides the PM with additional money over and above his base cost estimate and allows him to react to unprogrammed occurrences without asking for supplemental appropriations. TRACE is valuable to the acquisition system in that it promotes honesty and improves communications with command and Congress.

The Navy TRACE management concept presently being evaluated by NAVAIR differs from the TRACE concept used by the Army. The Navy plans to hold the TRACE deferral funds at the systems command level. Release of funds will require the approval of the SYSCOM commander. Thus, management of the Navy TRACE funds will occur two levels lower in the hierarchy than in the Army, which holds the TRACE funds at the secretariat level. Additional information on the use of the TRACE system by the Navy can be obtained from NAVAIRSYSCOM, AIR-12, (202) 692-7988, or AUTOVON 222-7988. The Army also has published a number of information pamphlets on the TRACE concept (series ALM-63-4476). These can be obtained from the U.S. Army Logistics Management Center, Fort Lee, Virginia 23801. A more extensive treatment of risk can be found in the publication Risk Assessment Techniques - A Handbook for Program Management Personnel, which is published by the Defense Systems Management College (DSMC), Fort Belvoir, Virginia.

SYSTEM ENGINEERING

It is easy to put a system together but difficult to put the "best" system together. System engineering is the discipline that ties together all aspects of a program to assure that the individual parts, assemblies, subsystems, support equipment and associated operational equipment will effectively function as intended in the operational environment. Early application of a disciplined and thorough system engineering approach will ensure that development of the system proceeds more quickly and smoothly. Problems which do occur can be scoped and resolved more efficiently. System engineering should assure that an organized, systematic understanding of all aspects of the system and the program have been developed and documented.

A useful definition of system engineering is given in MIL-STD 449.

"System engineering is the application of scientific and engineering efforts to (a) transform an operational need into a description of system performance parameters and a system configuration through the use of an incentive process of definition, synthesis, analysis, design, test and evaluation; (b) integrate related technical parameters and assure compatibility of all physical, functional and program interfaces in a manner which optimizes the total system definition and design; (c) integrate reliability, maintainability, safety, survivability, human and other such factors into the total engineering effort".

Although the system approach must be practical at all engineering levels, it is the program's system engineers who must provide the direction and discipline to the several contractor and in-house subsystem design teams if optimization of the system rather than the subsystem is to be achieved. The system engineering team will establish an analytical framework within which broad system requirements (Figure 4-12) are translated into concrete specifications and these in turn into specific subsystems, assemblies, subassemblies, and components. The application of system engineering management to any program must be consistent with the nature, complexity, and scope of the system and the imposed contractual requirements.

In an acquisition program, the system engineering management discipline includes performing the following tasks:

- o Planning controlling, and applying system engineering to transform a contractually defined operational need into a system/end-product definition and an optimized design that incorporates equipment, personnel, facilities, computer programs, and procedural data. The definition should be in terms of required system/end-product performance parameters and planned technical approaches tailored to the program requirements.
- o Identifying, providing, and controlling the detailed definition of the contract WBS in terms of technical tasks, assuring consistency and correlation of program technical requirements.
- o Identifying high-risk areas and continually assessing their impact on the program.
- o Determining program technical requirements and integrating the specialty efforts and such disciplines as configuration management and data management.
- o Providing the rationale and the definitive specifications for all hardware/software, facilities, and personnel required to carry out and support contractual requirements.
- o Establishing appropriate baselines and management reviews to permit effective engineering change control and monitoring.
- o Establishing the rationale for ensuring that engineering decisions leading to the selection of design alternatives are based upon system/end-product cost effectiveness considerations.
- o Establishing traceability of defined significant engineering decisions to the system engineering management activities on which they are based.
- o Planning system T&E programs to ensure meeting development and mission requirements, evaluating achievement, and reporting technical performance against program objectives both for early identification of problems and for visibility by management.

ment so that timely corrective action can be taken.

- o Providing appropriate and timely redefinition of program technical requirements in response to changes directed by the customer or the problems identified through evaluation of performance.

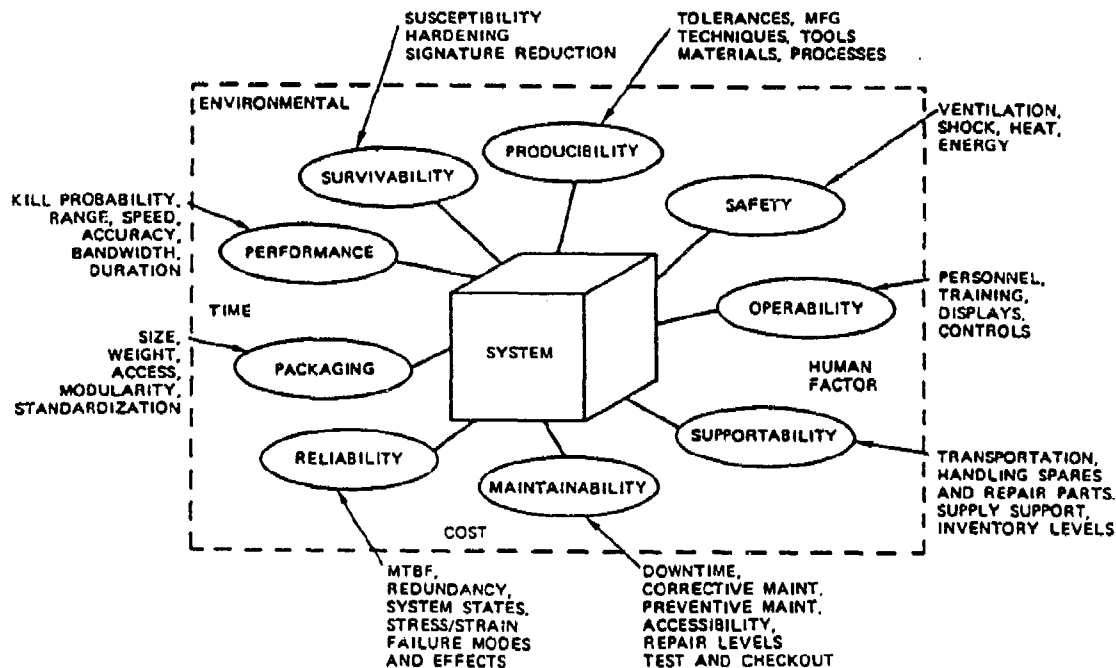


FIGURE 4-12. System Requirements.

One guiding principle in the application of system engineering is that organization of the system, not the subsystem, is paramount. It is not enough to design efficient subsystems and then hook them together, though this tendency frequently exists when several design teams are working on discrete subsystems or subassemblies. The PM, though his system-engineering team, must see that the trees do not obscure the forest and that system optimization, rather than sub-optimization, guides the acquisition process.

Design Reviews

Formal and informal design reviews are used to determine the adequacy of contractor and Navy in-house efforts toward achieving design goals. Participants should include design attribute specialists in reliability, maintainability, safety, and, particularly, logistic supportability. Reviews should include a preliminary design review, a critical design review, a design certification review, a functional configuration audit, a physical configuration audit, and a first-article configuration inspection.

Preliminary Design Review (PDR). The PDR is conducted by the developing agency prior to initiation of detailed design of the prototype subphase and subsequent fabrication of test articles. The PDR examines the basic design approach for a configuration item to see if it will meet specific performance requirements and be compatible with other configuration items in the overall system. The PDR normally occurs at the end of the engineering subphase and establishes the basis for release to prototype production.

Critical Design Review (CDR). The CDR, a formal review of the detailed design of a configuration item, is performed by the PM late in the prototype subphase when the design detail is essentially complete, but prior to drawing-release and fabrication of formal test articles. This review will help determine the maturity of the system and formally establish the design as the basis for activities such as:

- o Preparation of provisioning documentation
- o Preparation of technical manuals
- o Provisioning of initial spares
- o Personnel training

The primary purpose of the CDR is to formally identify the engineering documentation that defines the configuration item. At CDR, the degree of completeness of the preliminary Physical Configuration Identification (PCI) is assessed.

Design Certification Review (DCR). The DCR is a formal review, conducted by the developing agency, of the final design (preproduction prototype) subsequent to qualification testing and prior to OT&E and production start.

Functional Configuration Audit (FCA). The FCA will be performed on a prototype or pilot production unit that is represented to be a physical and functional equivalent of the product described by the design disclosure for the product baseline configuration. This is to verify that the item functions as required by the product baseline configuration specifications. The FCA establishes the functional requirements to which subsequent manufactured articles must conform.

Physical Configuration Audit (PCA). The PCA will be performed on a prototype or pilot production unit that is represented to be a physical and functional equivalent of the product described by the design disclosure for the product baseline configuration. This audit establishes the basic or initial product physical configuration identification to which subsequently manufactured items must conform until authorized changes are incorporated.

Preproduction Reliability Design Review (PRDR). The PRDR is a formal technical review to obtain mutual agreement between the developing agency, the test agency, the contractors, and the vendors that the system's established reliability is or is not acceptable to support commencement of production and deployment. The PRDR will be held between completion of initial initial operational test and evaluation (IOT&E) and the CEB/CMC/CNM first major-production decision point. During the PRDR, weapon system maturity will be evaluated primarily on the basis of

the Navy technical and operational test results. This includes all failure reports, failure analysis report, completed and recommended corrective actions, and planned/implemented retests. While all weapon system acquisitions are candidates for PRDR, only those selected by the DCNM(R&M) will require this review.

First-Article Configuration Inspection (FACI). FACI is conducted by the developing agency on the as-produced design following manufacture and acceptance testing of the first end-item configured for delivery to the Fleet.

COST MANAGEMENT/LIFE-CYCLE COSTING (LCC)

The PM is faced with the dilemma of developing a satisfactory system in an environment of (1) changing enemy threat, (2) increasing cost and shortages of skilled personnel, (3) increasing cost of systems development and critical materials, and (4) decreasing real budgets. Within the confines of this dilemma, the PM must get the most system for the least dollars and he must face the fact that as national priorities shift, unaffordable projects will be cancelled. The object of cost management and life-cycle costing is to obtain sufficient quantities of an operationally acceptable system at an affordable cost. To do this, the PM must utilize cost trade-offs, with emphasis on LCC, beginning early (Concept Exploration Phase) and continuing throughout the program. The challenge to the PM is to reduce system lifetime costs, achieve an acceptable military performance, and meet operational capability schedules - all simultaneously. Figure 4-13 breaks down total system cost into its component elements.

| COST BREAKOUTS | COST ELEMENTS | | | | | | | | | | | | | |
|---------------------------|---------------------------------|---------------------------------|---|-----------------------------------|-----------------------------|--------------|----------------|-------------------------------|---------------------------|------------------|----------------|---------------------------|--------|---|
| | RECURRING PRODUCTION UNIT COSTS | NONRECURRING PRODUCTION TOOLING | PRODUCTION SUPPORT (SYSTEM ENG, PM PRODUCTION DATA ETC) | PECULIAR GROUND SUPPORT EQUIPMENT | PECULIAR TRAINING EQUIPMENT | PUBLICATIONS | TECHNICAL DATA | CONTRACTOR TECHNICAL SERVICES | INSTALLATION AND CHECKOUT | FACTORY TRAINING | INITIAL SPARES | DEVELOPMENT COSTS RDT & E | MILCON | OPERATION, MAINTENANCE AND SUPPORT (O, M&S) |
| FLYAWAY COSTS | ● | ● | ● | | | | | | | | | | | |
| WEAPON SYSTEM COSTS | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | |
| PROCUREMENT COSTS | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | |
| PROGRAM ACQUISITION COSTS | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | |
| LIFE CYCLE COSTS | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

FIGURE 4-13. Total System Cost Elements.

In the process of cost management, cost parameters are established to discipline the acquisition process. Discrete cost projection elements (e.g., unit production costs, operating and support cost) are established as requirements. System development is continuously evaluated against these cost goals and thresholds with the same rigor as that applied to technical and schedule requirements.

DESIGN-TO-COST (DTC)

DTC is an acquisition management technique that establishes cost as an active design parameter - a parameter equal in importance to performance, schedule and supportability. The DTC concept recognizes that there are minimum performance requirements needed is a system is to be capable (performance floor), and that this capability must be achieved within a certain cost (cost ceiling) if the system is to be affordable. Within this performance floor and cost ceiling that are a range of acceptable solutions that will provide the cost-effective system. During development, these boundaries - performance floor and cost ceiling - provide designers with the flexibility for trade-offs to achieve an optimum balance among numerous program parameters. Cost is critical to this trade-off process and is addressed throughout the system life cycle. See DODD 4245.3, "Design-to-Cost" and NAVMAT P5242, "Design-to-Cost Guide - Life Cycle Cost as a Design Parameter".

DTC focuses on all acquisition and Operations and Support (O&S) costs of the LCC equation except R&D. An acquisition DTC goal is expressed in the form of flyaway (rollaway, sailaway) costs. DTC O&S goals may be expressed in dollars or other measurable factors, (e.g., reliability, maintainability, manpower) that are design controllable, significantly affect O&S costs and can be measured during test and evaluation.

Each program should establish a LCC figure to include a DTC acquisition component and a DTC O&S component. These DTC figures are stated as objectives in the conceptual phase but are in terms of goals and thresholds by the time of Milestone II. In this way, DTC becomes control tool for both the contractor and the PM for review at each significant points during the life cycle.

From the beginning, the focus is to identify alternatives, trade-offs, incentives and areas for corrective actions that will reduce cost without sacrificing system effectiveness. Concepts may include built-in test for ease of maintenance, use of value engineering, standard support equipment and prototyping for production along with many other ideas to reduce total cost.

COST ESTIMATES & CONTROL TECHNIQUES

The program's cost estimating and control techniques must be tailored to arrive at the best estimate and to control the systems total LCC. In the order of their occurrence, the different system cost elements may be separated into the following categories:

1. Research and Development (R&D). Costs primarily associated with the development of a new system, or capacity, to the point at which it is ready for procurement and operational use.

2. Investment. Costs beyond the development phase to introduce a new system or capability into operational use, including production, installation, and checkout, as well as special facilities and repair equipment required to support the system in the fleet.

3. Operation and Support. Recurring costs of operation, maintenance, and logistic support of the system.

The purpose of identifying and displaying system costs in separate categories is to facilitate their evaluation by the decision maker or planner. This categorization recognizes the fact that the cost associated with each phase of a system's life cycle will vary greatly. In some instances, cost will be very sensitive to the number of units of the system to be procured. While R&D costs are relatively independent of the number of system units to be procured, investment costs are a function of both unit cost and the number of system units to be deployed. R&D and investment costs are considered as one-time costs. By contrast, operation and support costs are recurring costs and, for systems with long service lives, may account for the major part of the system's total LCC.

The PM and his team should avoid viewing cost management as simply a tool or a discipline to be applied. They must view it as a developmental approach if it is to be effective. Cost management must be emphasized as a framework for system development, not a program appendage but a pervasive activity for the life of the program. To establish a cost-conscious environment and to reap the maximum benefit attainable while design possibilities are wide open, the concepts of cost management must be introduced and emphasized from the start of the Concept Exploration Phase.

During the Concept Exploration Phase, the PM must establish a method for making LCC comparisons among the several concepts being explored. The WBS is a powerful tool for use in making these comparisons. The WBS element matrix, Figure 4-4, discussed under "The Management Process", can be used to identify all hardware and effort expected over the life of the project. The various cost elements (labor and overhead, materials, contracts, etc.) can then be considered for each cell of the matrix. The aggregation of the cost associated with each cell is, then, life-cycle costing. Analysis of individual cell cost/performance/schedule trade-offs provides basic information for effective cost management.

The PM must consider the best balance between cost/performance/schedule/logistic supportability. For a proper balance between these considerations to evolve in a climate of flexibility, rigid goals should not be established prematurely.

System design iteration must continue through system validation with cost/performance/schedule/logistic supportability goals stabilizing at Milestone II. On the cost side of design trade-offs, the PM must

consider not only investment costs, but operating costs as well since the latter are where major cost savings may be realized. Affordability must be considered on both an absolute and relative basis. Without realistic affordability estimates, cost and performance requirements may be established at levels which lead to unaffordable systems or systems that are insufficient to counter the threat.

COST GROWTH AND INDEPENDENT COST ANALYSIS

DOD has been taken to task many times and from many quarters on the subject of cost growth connected with the acquisition of weapon systems. One of the causes of apparent cost growth has been the use of inaccurate cost estimates. Good estimates of not only development but of LCC are necessary to properly allocate limited resources. Accurate cost estimates are also required within industry to enable competitive bidding on contracts and ensure reasonable profit.

In order to provide constructive assistance to the PM in the development of credible estimates and adequately advise management, a number of independent cost estimating/assessment groups have been established. "Independent cost estimate/assessment" means that the analysis group is organizationally separate from (and neither a proponent nor an opponent of) the weapon system acquisition. Such independent groups have been established at OSD, SECNAV/CNO, NAVMAT, SYSCOM, and R&D Center levels.

The highest DOD organization level responsible for performing independent cost analysis is the OSD Cost Analysis Improvement Group (CAIG). The primary function of the CAIG, as set forth in DODD 5000.4, is to provide the Defense Systems Acquisition Review Council (DSARC) with a review and evaluation of both independent and PM cost estimates that are prepared by the services for presentation to the DSARC at milestone reviews. These CAIG cost reviews consider all elements of LCC, including R&D, investment, and operating support.

Similarly, the SECNAV/CNO Advisor for Resource Analysis and his staff (OP-917) generate and provide independent estimate and assessment of LCC of weapon system acquisitions for milestone reviews by the DNSARC and the Chief of Naval Operations Executive Board (CEB). This independent cost estimate/assessment is usually based upon parametric techniques that are different from the techniques used by PMs; typically, a top-down versus bottom-up review. The SECNAV/CNO Advisor provides a critical review and analysis of cost, schedule, performance, and other pertinent financial management aspects of acquisition category (ACAT) I, IIS and IIC programs for the CNO and the Deputy Under Secretary of the Navy, Financial Management (DUSN(FM)) prior to DNSARC proceedings. NAVMAT OIF4, the Director of Cost Analysis Division has the responsibility and capability for review and independent parametric estimates for ACAT I to ACAT III programs as part of the NAVMAT review process of such programs. The object of the independent estimate/assessment is to advise decision makers of the reasonableness of the PM's LCC estimate.

Periodic Reports. In addition to the cost analysis required as part of the milestone review process, the PM will be required to provide various command levels with periodic reports. This is necessary to keep

command informed of the program's progress as compared to schedules and projected costs. Among these reports are the Selected Acquisition Reports (SARs) for Congress, required quarterly following Milestone I for major programs (described earlier on page 3-XX), and the Acquisition Program Status Report of the NAVMAT Selected Acquisition Tracking System (NSATS) (discussed on page 3-XX) required for ACAT I, IIS and IIC programs. Other SYSCOM-specific reports are also required.

Availability of Assistance. The PM has a variety of sources for assistance in LCC estimation. These include the SYSCOMs and Navy R&D laboratories/centers, which can be tasked to provide assistance in the actual preparation of the cost estimates and proposed thresholds. Organized cost analysis groups exist at the NWC, NSWC, and NADC. These groups are dedicated to cost analysis in their respective mission areas. The other laboratories, while not maintaining formalized cost analysis groups, have individuals with the technical expertise in specific fields to assist the PM in early-on DTC/LCC considerations. In addition, the PM will want to consult the DOD Guide on Life-Cycle Costing, LCC Guidance for Naval Aircraft, Ships, and Missiles (available from NAVMAT-016), DODD 5000.28 Design to Cost, SECNAVINST 4000.31 Life-Cycle Costing, and NAVMATINST P-5242 Joint Design to Cost Guide: Life Cycle Cost as a Design Parameter.

In summary, the PM must do the following if he is to have a viable cost management program philosophy for his program:

1. Establish an environment where cost/performance/schedule/logistic supportability are given equal consideration in the selection of system concepts and design alternatives.
2. Emphasize flexibility in the imposition of early cost requirements.
3. Emphasize and implement cost management disciplines at the front end of the program.
4. Develop an in-house cost-modeling/cost-estimating capability during concept exploration for subsequent cost estimating and tracking.
5. Use affordability analysis as the basis for cost goals.
6. Develop a structure for accommodating cost goals at both life-cycle-costing and unit-flyaway levels.
7. In conjunction with 6, develop an integrated PM's office structure for life-cycle costing modeling and WBS planning control.
8. Encourage industry feedback on DTC/LCC estimating approaches.

RELIABILITY, MAINTAINABILITY AND AVAILABILITY (RM&A)

One of principal concerns of the CNO is the state of Fleet readiness. A major contributor to this condition is the relatively low reliability of systems and components and the inherent difficulty in

maintaining them at sea. These deficiencies can be overcome and avoided if the problem is recognized and addressed by management in the early phases of the acquisition program. The acquisition strategy must provide for reliability and maintainability (R&M) engineering support as an integral part of system engineering and equipment design. It must also provide for frequent assessment of the program's reliability, maintainability and availability (RM&A) capabilities.

RELIABILITY is defined as the duration or probability of failure-free performance under given conditions, and is usually expressed as mean-time-between-failure (MTBF). Numerous methods can be found for specifying reliability; however, they all boil down to the degree of dependability of a given item. Reliability is a design attribute. It either is or is not designed into the equipment and cannot be improved *per se* either by testing or by the actions of logisticians or support personnel, although it can be improved through TAAF procedures.

MAINTAINABILITY is defined as the ability of an item to be retained in or restored to a specific condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. Maintainability can be expressed in a number of ways, the most common being mean-time-to-repair (MTTR) and maintenance man-hours per operating hour.

AVAILABILITY is defined as the probability that a system or component is in an operable state at the start of a mission called for at an unknown (random) time. Availability is a function of reliability, maintainability, and fleet support and is maximized by balanced trade-offs of these parameters during the design and development process.

Operational Availability (Ao) is an index of weapon system material readiness, including system software where applicable, in a mission environment. It does not attempt to capture personnel readiness nor the probability of mission success. It is instead a measure of the probability of an item being in a condition, generally referred to as "up", such that it can perform its intended function, within acceptable limits of degradation, when called upon.

The readiness of a system or equipment to perform an intended function is influenced by its: RELIABILITY - the duration or probability of failure-free performance under stated conditions; MAINTAINABILITY - the extent to which the item can be retained in, or restored to, an up condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair; and SUPPORTABILITY - the degree to which the above-mentioned personnel, training and resources (especially spare parts) are in place so as to minimize logistics-related delays within the maintenance processes.

Thus, in addition to being an important characteristic in its own right, Ao can be thought of as a vehicle for consolidating the combined and interdependent effects of reliability, maintainability and supportability.

R&M must be uppermost in the minds of people at all levels and in all functional areas of acquisition management. The pursuit of R&M is more a disciplined approach to the acquisition process than it is a particular set of practices and procedures. Figure 4-14 indicates the major interdisciplinary interfaces of integrated R&M programs.

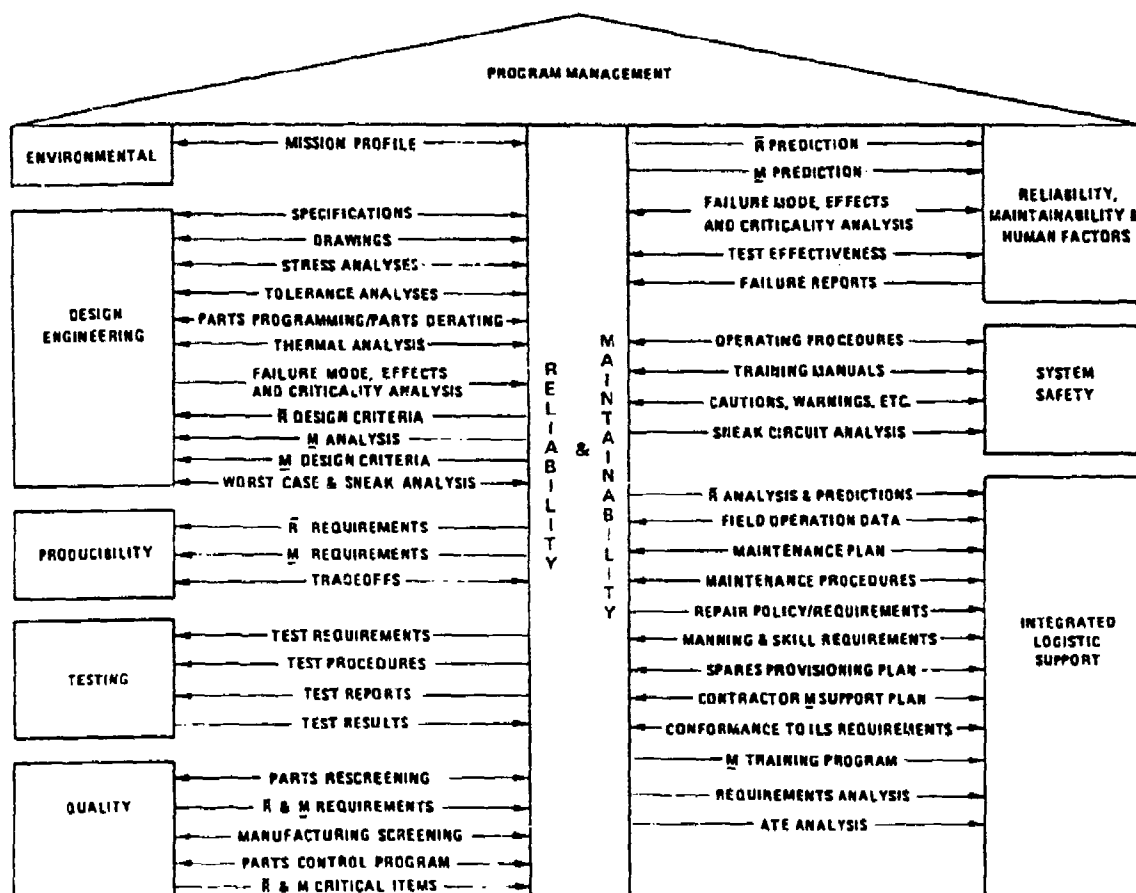


FIGURE 4-14. R&M Interdisciplinary Interfaces.

The goal of R&M efforts is, of course, availability. Because products that are substantially more reliable will diminish the need for maintenance, reliability becomes a very important design attribute. The reliability of a system depends on its design. The technical design team must know the environmental conditions in which the system will operate (levels of temperature, vibration, shock, humidity, salt-fog/spray, altitude, etc.) and the length of time in each; this information is included in the mission profile (see MIL-STD-1470). Beginning as early as the Concept Exploration Phase, the emphasis should be on simplicity in the design for these conditions, keeping to a minimum the use of high-risk advance concepts and parts whose reliability track records

lack the test of time. To maximize the likelihood of achieving high reliability, the allocation of an overall numerical reliability value to each of the system's subassemblies, as well as the predictions supporting design trade-off decisions, must reflect the complexity, criticality and technological risk in each subassembly.

The selection and application of parts and materials play a significant role in reliability achievement. A parts control program - including parts derating - is essential to establish and maintain (1) qualified parts lists, (2) specification control drawings for parts procurement from approved sources, and (3) laboratory facilities for testing and screening parts and materials.

A comprehensive program of development test and evaluation (DT&E) and operational test and evaluation (OT&E) is essential for the attainment of RM&A goals. The purpose of testing is to determine whether or not the emerging design meets the stated performance requirements, including R&M. Any shortfall must stimulate redesign until the requirements are met or other compensatory action taken.

Once production commences, quality control becomes the key factor in assuring that the reliability inherent in the final design is not degraded by the manufacturing process. A manufacturing screening program should be initiated in accordance with NAVMAT P-9492. A failure analysis should proceed any corrective action taken to alleviate the adverse effects of marginal manufacturing processes or to enhance productivity.

Good contracting is one of the keys to an effective RM&A program. It is often assumed that reliable and maintainable products will result from requiring a contractor to formulate and conduct a reliability and maintainability program in accordance with appropriate military standards. However, the contractor cannot be expected to offer better R&M characteristics than the specification requires, since he would thereby risk loss of the contract to a lower bidder. The PM, with the assistance of the procurement team, should ensure that the R&M requirements are quantitatively stated in the solicitations and in the negotiated contracts, that they are realistic and achievable and more importantly, that the equipment design exhibits the specified R&M characteristics before it is accepted for Naval service. Figure 4-15 indicates a time-phase breakout of the principal R&M related tasks.

For further information on R&M, the PM should consult DODD 5000.40, SECNAVINST 3900.36, OPNAVINST 3960.10, NAVMATINST 3000.1 and 3900.13 and MIL-STD-756, -785 and -470.

QUALITY

Quality is the composite of desirable material attributes, including performance and must be designed into the product during its development phases. It will never be realized, however, if there is not also a strong quality assurance program that mandates a rigorously conceived and practiced quality control program.

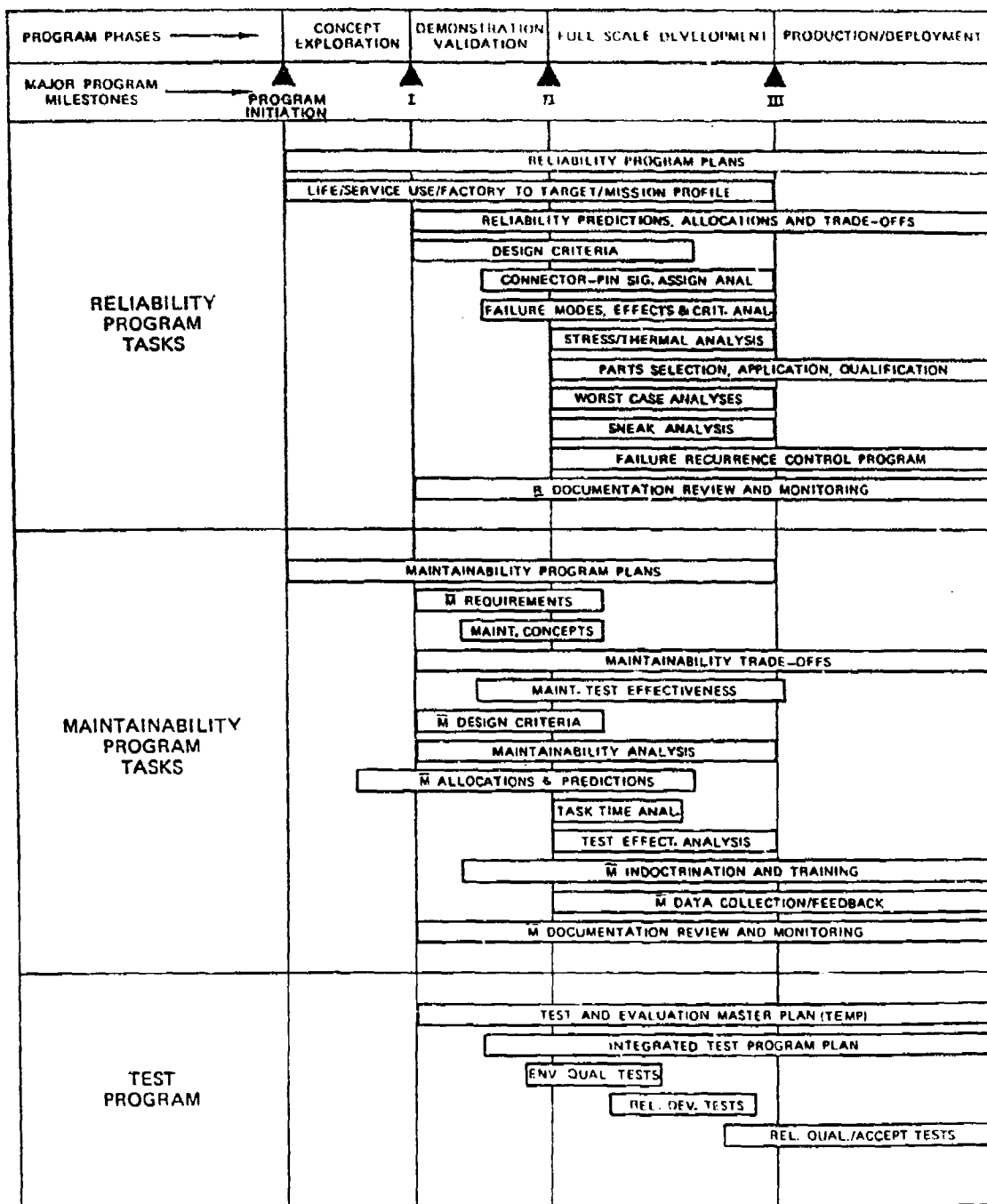


FIGURE 4-15. Time Phase Breakout of Principal R&M Related Tasks.

Quality Control (QC)

The QC program must ensure that the product to be delivered does in fact uniformly meet or exhibit the quantitatively and qualitatively expressed performance and compatibility requirements and other quality

(design) attributes required under the contract.

Quality Assurance (QA)

QA is the planned and systematic pattern of all actions necessary to provide adequate confidence that material, data, supplies, and services conform to established technical requirements and achieve satisfactory performance. QC is the management function that controls the quality of raw or produced material exercised for the purpose of preventing the production of defective material.

The major contributors to the depressed quality of the hardware, software, and technical data reaching the Fleet are (1) the lack of QC in the processes and procedures by which military products are developed and produced, and (2) the failure to establish and enforce meaningful QA programs for the detection of and early remedial action on breakdowns in the area of QC.

Quality Management

Obviously the program team, including the contractors, readily subscribes to and strives for the goal of development, test, and acceptance of a quality product and, generally speaking, is at least moderately successful in achieving that goal if given enough time and resources. What is not so obvious is that all hands must be equally dedicated to the policing operation that needs to be mounted and continued with dedication and vigor, if the quality attributes of which the design is capable are to be consistently exhibited by the product presented by the contractor for acceptance.

When the PM seeks adequate confidence that the delivered product is a quality product, that confidence can be derived from only two sources. One is the confidence gained when the product is observed to perform properly when subjected to the prescribed production acceptance tests. The other, by far the most important, is the confidence gained when one knows that the materials used, the workmanship going into, and the processes, procedures, and in-process tests employed in the fabrication and delivery of the product were as prescribed for every item being delivered. If that confidence is to be gained, and if the Fleet inventory is not to be contaminated by faulty equipment, the control of quality going into the design in the first place and the practice of rigorous and continuing QC in product manufacture are essential.

The PM is required by DODD 5000.1 and SECNAVINST 5000.1 to ensure that complete and realistic QA and QC requirements are incorporated in the mission need decision (MND), and in contract documents (solicitations, contracts, and change orders). He must also establish necessary quality data collection, reduction, feedback, and corrective action requirements, and an adequate DCAS evaluation of contractor QA/QC programs (SECNAVINST 4355.14). The PM must also ensure that consideration is given to quality requirements, quality history, and capabilities by source selection boards.

The PM is also responsible, through his functional support team, for reviewing contractor QA/QC programs to ensure that all essential actions related to product quality are being pursued in an organized and acceptable manner. He will address QA/QC requirements, plans, achievements at the appropriate milestone decision review point.

Quality Program Assistance

It is easier and less expensive to demand and get good QC in the development and fabrication of a product than it is to redevelop the item or to purge an inventory that has been contaminated. Like many other activities that involve recurring actions, the tendency is to relax when things are going well or even to loosen the controls that have caused things to go well. This is one of the many times when a knowledgeable in-house laboratory or center that has been intimately involved with the evaluation of the product can perform a useful service by helping to develop a good QA/QC program and assist local DCAS implementation of it. The PM should enlist the service of a knowledgeable government activity such as a Navy laboratory to render assistance in quality management. Enlisting the service of an independent Navy laboratory or center to audit the performance of contractors, DCAS/PRO, and test activities might seem to be overkill; however, the importance of ensuring the delivery of a high-quality product with minimum latent defects into the service inventory is ample justification. Delivery of inferior products not only lays the groundwork for expensive and time-consuming inventory purging and rework programs, but robs the using commanders of their operational capability. QC must be practiced rigorously and on a continuing basis if gradual and, perhaps, catastrophic quality deterioration of the product is to be avoided.

SECNAVINST 4355.14, Quality Assurance, is implemented by NAVMATINST 4855.1. These two instructions together with MIL-STD 109 establish Navy policies for QA programs. PMs are encouraged to designate a project support officer for QA who will structure and implement a QA program tailored to meet the needs of his particular acquisition program.

LOGISTIC SUPPORTABILITY

To those responsible for the operation of military systems and equipment, it has become increasingly obvious that a major limiting factor in their operational capability and availability is logistic support. Operational commanders carefully watch the statistics on those items of equipment that are not operationally ready because of maintenance or supply difficulties. They have come to recognize the importance of having an adequate supply of spare parts, test and support equipment, and a sufficient number of trained personnel to operate and maintain the system. In short, they have come to recognize the importance of integrated logistics support (ILS).

The achievement of logistic supportability necessitates that all support requirements be considered, planned, and budgeted for from the beginning of the development process. DODD 5000.1 requires that "Logistic supportability shall be a design requirement as important as cost,

schedule, and performance. A continuous interface between the PMO and the manpower and logistics communities shall be maintained throughout the acquisition process". This amplified by SECNAVINST 5000.1, which requires that each program charter include the designation of a logistics manager to assist the PM.

One of the major duties of the logistics manager, in conjunction with the PM, is to develop and update an ILS Plan (ILSP). The ILSP provides a framework for organizing and managing the resources and activities which will culminate in efficient, cost-effective Fleet support for the system under development. The ILSP reduces uncertainty in support planning, ensures compatibility of resources, and diminishes the duplication of effort.

Integration is the key to good support planning. ILS is a technique for designing the support concurrent with the system design so that ILS options and trade-offs can be considered before the design is frozen, and the optimum balance of logistic support elements can be achieved. The principal ILS elements include:

1. Maintenance planing
2. Manpower and personnel
3. Supply support
4. Support equipment
5. Technical data
6. Training and training support
7. Computer resources support
8. Facilities
9. Packaging, handling. storage and transportation
10. Design interface

The elements of ILS are planned simultaneously during the development phases of a program. The maintenance plan is the lead document because the concept of maintaining the system affects the planning of all the other elements. For example, technical manuals must be consistent with the levels of repair defined in the maintenance plan, and training schedules for maintenance personnel must be coordinated so that the correct number of personnel with the required skills is available when the system is introduced into the Fleet.

The ILS elements are to be merged into the ILSP through logistic support analysis (LSA), which includes "the use of appropriate analytical tools and models throughout the acquisition cycle to evaluate alternative support concepts, to perform trade-offs between system design and ILS elements, and to perform trade-offs among ILS elements in order to meet system readiness objectives at minimum cost". (DODD 5000.39).

These trade-offs must be made early in the acquisition process, when the system is relatively undefined. Supportability should be an important factor in the contractor's choice of design, and support requirements should be included in the design specifications. Design details with significant support impact can extend the life of the equipment, reduce maintenance time and cost, increase system availability, and reduce supply cost over the system's life cycle.

The support problems to be dealt with will vary according to the complexity and operational characteristics of the system. The logistics functions must be tailored to each acquisition. A listing of ILS considerations, broken down by milestones, is set out as enclosure (3) to DODD 5000.39.

There are many related disciplines and activities which are not considered ILS elements but which ultimately have an influence on support. Reliability, maintainability, human factors engineering, safety, data management, and configuration management are some of these.

Prior to Milestones I, II, and III for ACAT I and II programs and selected ACAT III and IV programs, a Logistics Review Group (LRG) headed by the Deputy Chief of Naval Material for Logistics (DCNM(L)) will review the program's ILS program and assess its adequacy. This will include an assessment of the planning for ILS management, analysis, resources, scheduling, contract structure, and budget, relative to the program objectives. The LRG will report to the Chief of Naval Material (CNM) who will certify the ILS program prior to commitment of additional resources or new contractual commitments for the acquisition of material. For ACAT III and IV programs not selected for CNM review, ILS assessment and certification is accomplished by a SYSCOM LRG. Enclosure (3) of NAVMATINST 4105.3 contains a list of the ILS certification factors.

Further assistance in implementing logistic support for an acquisition program may be obtained from MAT-043, NAVAIR-401, NAVELEX-811, NAVSEA-90L, the principal (lead) field activity or the Naval Weapons Engineering Support Activity, Washington Navy Yard.

MANPOWER, PERSONNEL AND TRAINING

The DON continues to experience serious problems in the supply of adequate numbers of skilled personnel for operating and maintaining weapon systems. The identification of manpower and training support has typically come as an afterthought in the acquisition process. As a result, the Naval Military Personnel Command (NMPC) which is responsible for manning systems with skilled personnel, has been operating in a reactive mode, responding as best it can to requirements thrust upon it by system entering the Fleet.

Manpower costs have increased rapidly in recent years, and now account for approximately 55% of a ship's annual operating expenses. Manpower has become the single most expensive element in the Navy's inventory and is a major determinant of system LCC. Since up to 70% of system LCC are determined by decisions made during the Concept Exploration Phase, the PM and his staff must consider the impact that their decisions will have on human resources.

Human resources and the hardware/man interface are major determinants of a system's operational effectiveness. In spite of this, they have been given little or no consideration during the early design phases of most Navy systems. System design engineers have made their decisions based almost completely on the trade-off of schedule and

performance considerations, and today this is neither working nor is it affordable. Manpower and training support requirement must be considered as design trade-off variables. Figure 4-16 shows the manpower, personnel, and training support (MP&TS) planning input requirements by phases in the acquisition process.

Shifting manpower, personnel, and training emphasis into the design arena places the responsibility for its early consideration squarely in the hands of the PM-system designers and the development agency. Current DOD and DON policy clearly reflect this fact. Manpower, personnel, and training requirements analyses must be made early in the acquisition

| MAJOR RDT&E PROGRAM PHASES | CONCEPT EXPLORATION | DEMONSTRATION AND VALIDATION | FULL-SCALE (ENGINEERING) DEVELOPMENT | PRODUCTION/DEPLOYMENT |
|--|---|---|--|---|
| PRIMARY DECISION POINTS | PROGRAM INITIATION | MILESTONE I | MILESTONE II | MILESTONE III |
| MANPOWER, PERSONNEL, AND TRAINING CONSIDERATIONS IN JMSNS/OR/ROC | MP&TS CONCEPT | DRAFT NAVY TRAINING PLAN (NTP) | PRELIMINARY SHIP MANPOWER DOCUMENT (SMD) OR INFORMATION (SMI) OR PRELIMINARY SQUADRON MANPOWER DOCUMENT (SQMD) | UPDATE AND REFINE SMD/SMI |
| | ANALYSES OF MAN/MACHINE FUNCTIONS | MP&TS INPUT TO INTEGRATED LOGISTICS SUPPORT (ILS) PLAN | NAVY TRAINING PLAN CONFERENCE | UPDATE AND REFINE NTP |
| | MP&TS INPUT TO FUNCTIONAL IMPLEMENTATION PLAN | MP&TS INPUT TO REQUESTS FOR PROPOSAL (RFP) | UPDATE NTP | REFINE MP&TS SECTION TO ILS PLAN |
| | PRELIMINARY MANNING ESTIMATES FOR EQUIPMENT/SYSTEMS | TRADEOFF STUDIES FOR EQUIPMENT/SYSTEMS | DRAFT CREW PHASING AND SCHEDULING PLAN | MP&TS EVALUATION CRITERIA FOR FOT&E |
| | TRADEOFF STUDIES FOR EQUIPMENT/SYSTEMS | PRELIMINARY SHIP/SQUADRON MANNING DOCUMENT (PSMD/PSQMD) | NEW NEC REQUIREMENTS | MONITOR AND EVALUATE CONTRACTOR MP&TS |
| | | | UPDATE MP&TS SECTION TO ILS PLAN | FINALIZING CREW PHASING AND SCHEDULING PLAN |
| | | | POM MANPOWER INPUT FOR IDY&E, TECHEVAL/OPEVAL, AND TO SUPPORT FLEET DELIVERIES | |
| | | | DEVELOP MP&TS CONTRACTOR EVALUATION CRITERIA | |
| | MONITOR AND IDENTIFY MP&TS PROBLEM AREAS | MONITOR AND IDENTIFY MP&TS PROBLEM AREAS | MONITOR AND IDENTIFY MP&TS PROBLEM AREAS | MONITOR AND IDENTIFY MP&TS PROBLEM AREAS |

FIGURE 4-16. MP&TS Requirements in the Acquisition Process.*

* Typical products/actions. Specific outputs and time phasing may vary as mutually agreed. From NAVSEAINST 5311.1, June 1977.

process, with increasing detail required in successive phases. DODI 5000.2 requires that:

"New systems shall be designed to minimize manpower (number, grades, specialty, and skill levels) needed. Service studies projecting personnel skill level availability to meet manpower requirements shall be included at program initiation as constraints in system design and shall be integrated with human

engineering design criteria to form the basis on initial operating and support concept studies and refined as system development progresses, to form the basis for crew station and maintenance design as well as personnel and training requirements, training devices and simulator design, and other planning related to manpower and personnel. Goals and thresholds for manpower number and skill levels shall be established and evaluated in T&E. Plans for training shall consider trade-offs conducted among job aids, formal training, on-the-job training, unit training, and training simulators. Each program shall develop a cost-effective plan for attaining and maintaining the personnel proficiency needed to meet wartime mission objectives. Such planning shall consider provisions for unit conversion to the field system and training of reserve component personnel".

Designing in Relation to Human Resources. The primary factor driving all manpower costs are the number, complexity, and frequency of operator and maintainer tasks. These factors determine:

1. The number of maintenance and operator personnel required.
2. The required aptitude levels of these personnel.
3. The experience levels required to perform satisfactorily.
4. The amount of general and specialized training required.

Various system design concepts have more or less impact on the complexity of operator and maintainer tasks. The manpower-and-training cost consequences of these concepts must be traded off against other cost-benefit consideration beginning in the Concept Exploration Phase.

The manpower development process includes optimizing the manpower requirements for the system under development, establishing the operator requirements for various states of readiness, assessing all maintenance requirements, establishing total administrative and support workloads, taking into account the time required for irregular and utility tasks, and making allowances for average productivity levels.

Though the system designer cannot control all of these factors, it is important for him to be responsive to overall manning problems and the availability of personnel, and to be aware of the many variables that he does impact in the overall manning equation. These variables include:

1. Operator requirements
2. Preventive and corrective maintenance requirements
3. Training and service diversion requirements
4. Rate/rank and skill requirements
5. Cross-utilization of personnel for various conditions of readiness
6. Administrative and support workload
7. Utility (miscellaneous task and evolution) requirements
8. Facilities maintenance (cleaning, painting, etc.)
9. Productivity allowance factors
10. The standard work week as stipulated by the CNO.

The design engineer directly influences items 1, 2, 3, 4, and 5 through the election of design alternatives. In addition, minimizing the number of system personnel can indirectly affect items 6 and 7. On shipborne systems, important secondary savings can result from decreased requirements for onboard service and administrative personnel. These savings can come about either through a reduction of the absolute number of operation and maintenance personnel on board, or by transferring a greater portion of the support and administrative burden to tender or shore-based facilities. Since support and administrative personnel constitute 20-25% of a typical ship's crew, these additional indirect savings can be substantial.

Training Aids. The PM should consider the development of training aids and other ancillary equipment, such as training manuals and simulator, to support his finished acquisition. The use of training aids and simulators has become more and more important as the complexities of systems have increased and the cost of expendables such as missiles and projectiles, as well as the cost of ship steaming days or aircraft flight hours, have increased. Where once it was practical and efficient to develop bomb delivery accuracy or gunnery efficiency by practicing with live or dummy ammunition, it is now prohibitively expensive to do so. Yet it is still essential that personnel gain experience in the use of modern equipment and learn to overcome conditions such as electronic countermeasures (ECM) that are encountered in wartime. One means of obtaining realistic training is the use of system simulators and sophisticated training devices that provide feedback on operator effectiveness and performance. Such devices must be as carefully developed as the real system to provide the maximum benefit of training and to ensure that the simulated conditions and operations match the operational environment closely. The development of such "trainers" must proceed at the same pace as that of the final system.

Obtaining Assistance. The Navy has recognized the importance of minimizing manpower, personnel and training costs and is implementing a Navy-wide effort to achieve this goal. As a result, it should be possible for the PM to obtain general advice and guidance from OPNAV 01, and particularly from the HARDMAN (Military Manpower/Hardware Integration) Development Section (OP-111C0; from specialists in manpower, personnel, and training within his own SYSCOM; and from the Naval Personnel Research and Development Center (NPRDC), San Diego. The HARDMAN Section has developed and tested methodologies for determining manpower requirements and training requirements in addition to developing and testing a series of LCC models. The methodologies and models are designed to be applied throughout the weapon system acquisition program by the PM and his staff in order to determine the manpower, personnel, and training implications of his program. NPRDC has been developing "An Engineers Guide to the Use of Human Resources in Electronic Systems Design" (NPRDC TN 79-8) as well as instructional material in related areas. The NMPC 5/6, can also provide assistance. The Naval Education and Training Program Development Center, Pensacola, and the Naval Training Equipment Center, Orlando, have proven helpful in the past on questions of training and training equipment.

EMBEDDED COMPUTER RESOURCES

The combat launch of an aircraft without its missiles or the sortie of a submarine without its torpedoes makes successful destruction of enemy forces highly unlikely. To any professional, this fact is obvious; ordnancemen, commanders, and deck seamen all agree. Far fewer, however, know that weapon systems with full armament installed may be equally failure-prone because of embedded computer resource (ECR) deficiencies. In the age-old evolution of the science of warfare, it will take more time to establish that dropping a computer "bit" in today's dog fight is just as serious as was a caveman dropping his club in battle.

PMs universally have become aware that we can no longer fly, dive, steam, or fight without ECRs in most of our weapon systems. We use ECRs to make our systems operate, to test them, to produce them, to adapt them, and to keep them responsive to changing threats. Software can confer many of the "ilities" on a system - changeability, flexibility, capability, versatility, even affordability, to name a few. ECRs can make the same airframe usable and effective in a fighter or an attack role and theoretically reduce the number of airframes needed to perform the combined tasks, provided the tasks are performed sequentially and not concurrently. There is seemingly an endless number of benefits to be gained through the increased use of ECRs.

There also can be a nightmare of system performance failure, cost overrun, schedule slippage, and even loss of program control awaiting the PM who does not manage software development with the skill and to the same extent that he manages hardware development. Equal emphasis on software and hardware should apply from the beginning. The ECR must be evaluated as to its supportability: common high order language, availability of compilers, transportability of coding, documentation deliverables, etc. Universal test equipment availability for the hardware and for the software are features which should also be evaluated. In short, system software should be treated as a vitally important configuration item just as much as is the engine in an aircraft weapon system selected for development.

System software management tools and techniques have matured in recent years. Standards and specifications have been produced. These are now beginning to be used in software development in much the same way that MIL-SPECS have long been used in the hardware development field. Instructions exist which establish a minimum set of required documentation to be produced as part of system software development.

The defense management policy for mission essential ECRs is articulated in DODD 5000.29, Management of Computer Resources in Major Defense Systems, which established a Management Steering Committee for Embedded Computer Resources to provide appropriate oversight; DODI 5000.31, Interim List of DOD Approved High Order Programming Languages (HOL); and in the proposed DODI 5000.5X, Instruction Set Architecture (ISA) Standardization Policy for Embedded Computers.

These policies and instructions, if understood and heeded by both industry and the Navy PMs, will assure contractor's responsiveness to

the Navy's requirements. Policies have been developed and promulgated in the broad area of system software development and support (see SEC-NAVINSY 3560.1). NAVMAT policy, for example, requires the use of Navy standard higher order languages such as Ada, CMS-2 and SPL-1. Policy documents in this regard are called Tactical Digital Standards (TAD-STAND) and are promulgated by the Tactical Embedded Computer Program Office (TECPO), (MAT-08Y). There are five TADSTANDs, designated A-E. They deal with standard definitions for ECRs in tactical digital systems; standard embedded computers, computer peripherals, and input/output interfaces; computer programming language standardization policy for tactical digital systems; reserve capacity requirements for tactical digital systems; and software development documentation and testing policy for Navy mission critical systems.

Navy policies include the requirement to transition system software support from the developing contractor to another agency at an appropriate time. This transition is usually to a designated Navy facility where an in-house software support activity is established.

Software management has been recognized by successful PMs as requiring early, intensive, continuing management. There is no program phase that is too early for concern with software. In fact if the software standards to be utilized are not identified as early as issuance of the system solicitation, some form of disaster is highly probable. Hardware development that is allowed to proceed in advance of software decisions will generally constrain system design. Program decisions in good designs are made with engineering balance hardware and software considerations.

PMs are enjoined in DOD-STD-1679A to: (1) make extraordinary efforts in the development phase to ensure maximum reliability and maintainability of software; (2) ensure software is designed to facilitate efficient change (even at the expense of technical design efficiency, if necessary); and (3) design software which is strongly influenced by factors which will reduce LCC - particularly those standards relating to design, languages, inter-system and intra-system interfaces.

These guidelines emphasize that software should be designed to make changes easy - and that it is worth extra time, effort, and resource expenditures during the development phase to make the software reliable, maintainable, and less costly over its operational life span. These guidelines, if followed, can help to avoid major problems in system operation in the Fleet. If software is allowed to become complicated and overly refined, a simple change in one or two parameters can demand that major software segments be replaced. Careful design (including memory medium) with regard for probable programming change requirements can simplify the software change problem throughout the system's service life. Costs of updating and maintaining software during the system's service life can be controlled only if the PM forces the design in a reliable, maintainable direction.

The PM needs software expertise available in his program from the outset. This needed expertise is frequently in short supply. Early designation and establishment of a software support activity, to which weapon system software support for the operational system will be tran-

sitioned, is an effective way to acquire expert software development advice early in a program. Further, this early designation provides technical assistance in monitoring the development progress, and in analysis and solution of software development problems as they occur. Finally, this procedure should also ensure a smooth transition of software support responsibility at the proper time. Activity personnel will be thoroughly familiar with the system software by virtue of participation during its development. Assistance and initial guidance in interpreting and applying official guidelines for software management are available from the offices listed below.

NAVMAT: Tactical Embedded Computer Program Office (TECP0),
MAT-08Y
NAVSEA: Tactical Embedded Computer Resources Program Office,
PMS-408
NAVAIR: Computer Resources and Avionics Systems Division,
AIR-543
NAVELEX: ELEX 814

There are no golden rules which, if followed, will avoid software problems in the development of a software intensive system. Treating software development as an effort equally important to and concurrent with hardware development has produced the best results. Paying too little attention to, or neglect of software has produced system failures. As in all aspects of program management, in software development as in total system development, there is no substitute for understanding what must be done and doing it at the proper time in the acquisition process.

DESIGN FOR THE ENVIRONMENT

Naval systems and subsystems must be designed to survive and function in the operating or combat environment. Specifications governing the design must reflect this need. The specifications must also provide for system survivability in the punishing transportation and storage environments that are likely to be encountered during the system's life. The formulation of these specifications cannot be undertaken until the environmental compatibility requirements for the systems and subsystems have been developed in quantitative form.

The environmental conditions likely to be encountered by a new system may be considerably different from those encountered by the system it replaces. The altitude, speed, and acceleration forces for aircraft systems and associated weapons have changed with each new generation of aircraft. Similarly, a subsystem's location on an aircraft or ship will greatly influence its environment, as will new materials use for construction, the increased density and diversity of electromagnetic fluxes, renewed emphasis on arctic warfare, and many other factors.

Unfortunately, environmental specifications for ships and aircraft systems have traditionally been covered by general specifications. These are often out of date and lack the detailed information required by the system designers, logisticians, T&E planners, and other involved

in the system acquisition process. Outmoded or insufficiently detailed specifications have resulted in both over- and under-testing of systems and have lead to some substantial delays of IOC.

PMs are encouraged to have specific environmental compatibility requirements for their systems and equipment developed early in the acquisition process. These requirements should be based upon anticipated use scenarios in much the same way as is done for expendable ordnance items (a methodology described in MIL-STD-1670). It is also recommended that the PM require those who submit concepts for evaluation in the Concept Exploration Phase to identify and include a description of environmental conditions unique to their systems proposed mode of operation, or logistic support.

Generally speaking, designers of ship and aircraft systems and their included non-expendable subsystems are concerned with achieving compatibility only with the combat environment. Designers of expendable ordnance items and many Marine Corps items, however, are concerned not only with the combat environment, but with the whole factory-to-target sequence of environments as well. These items must receive special attention in the determination of environmental compatibility requirements that will apply to their development, T&E, production, delivery, maintenance repair, and employment by the using Commands. For these missiles, torpedoes, remotely piloted vehicles (RPVs), and other such items, the planning and detailing of a Life Profile (LP), variously called a Factory-to-Target Sequence (FTTS) or Service-Use-Profile (SUP), and the preparation of a Missile Profile (MP) and Environmental Design Criteria Documents (EDCD) are early, essential activities in the planning process. These documents and reports require a time-phased description of the events and environments that an item will experience from manufacture to final expenditure or removal from the operational inventory including the item's logistic profile and one or more mission profiles.

Missiles and torpedoes are unique among the types of ordnance equipment employed in training and combat operations. Their uniqueness derives, in part, from the fact that although they are categorized as expendable, they are still subject to overhaul and maintenance procedures. They can and often do spend long periods of time in both live and dead storage. They contain explosive material and hazardous fuels as well. Inadvertent detonation or ignition, or failure to function properly after intentional detonation or ignition commands, may have catastrophic consequences. Thus it is necessary that these weapons be designed to withstand the many extremes of temperature, shock, vibration, humidity, etc., to which they will be subjected from the time they are accepted at the place of manufacture to the time they actually reach the target (see Figure 4-17). To so design these weapons, the Life Profile must be worked out and the extremes of the several environments that will be experienced by the weapons must be determined.

During the Concept Exploration Phase the PM will require a MP. This report is extracted from the LP and quantitatively describes the various environments that a given weapon may encounter. Each environment is categorized as damaging or non-damaging and the rationale for such categorization is given. A MP for an all-up air-launched missile,

for example, would take into consideration such factors as:

1. Proposed logistics cycle
2. Means of transportation (truck, railroad, dolly, etc.) of the weapon from one location to the next

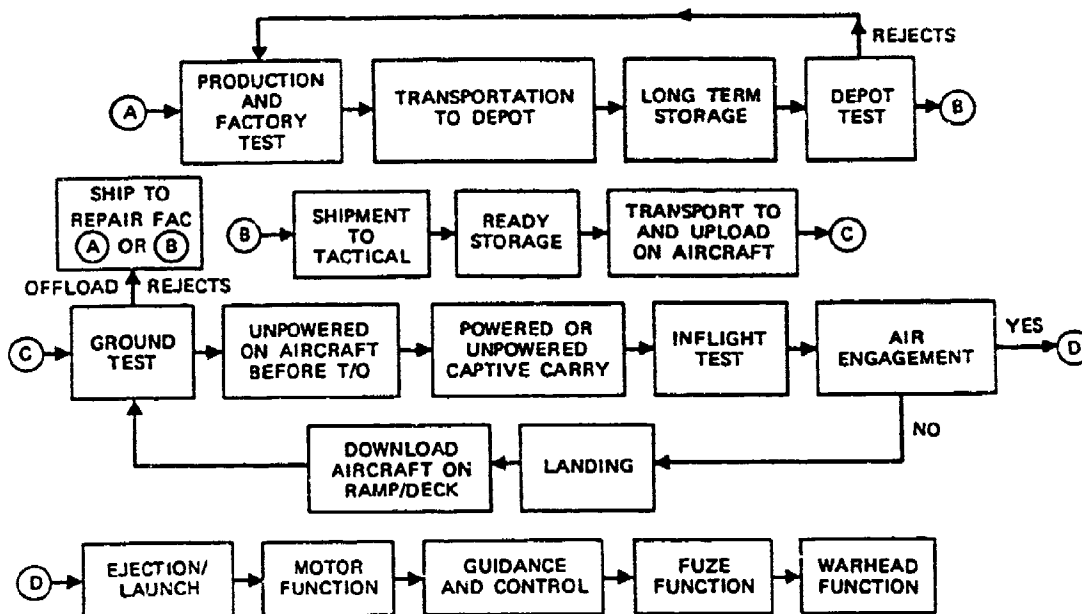


FIGURE 4-17. System Life Cycle Profile.

3. Range of time spent at each location and the environment encountered there
4. Identity of carrying vehicle (ship or aircraft) on which the weapon will be stored or carried, or from which it will be launched
5. Anticipated locations, in or on the carrying or launching vehicle, where the weapon will be carried or launched from, and the mix of stores carried by that vehicle
6. Anticipated combat tactics employed by the carrying or launching vehicle and its maneuvering characteristics and limitations (speed, altitude, depth, etc.)
7. Anticipated mission profile of carrying or launching vehicle
8. Anticipated operational deployment areas of the carrying or launching vehicle (sea, land, arctic, worldwide, etc.)
9. Required life span of the candidate weapon component (storage life, service life, number of flights, etc.)
10. Operational experience of existing similar weapons

From this information the design team can develop the EDCD. The EDCD contains specific quantitative design parameters, environmental design requirements, and an environmental test plan. Since the EDCD are an integral part of the development specification that defines the allocated baseline configuration for the FSD Phase, LP/MP/EDCD activities should commence early enough in the Concept Exploration Phase that the EDCD can be completed and approved by the PM well before the conclusion of the D&V Phase.

NWC at China Lake, California, has developed an information data base and a capability that permits them or others to develop LPs, MPs and EDCDs for weapon and other ordnance material.

SURVIVABILITY

Survivability is the capability of a system to continue to carry out its designated missions in a hostile environment. Survivability is a function of both susceptibility (the combination of factors that determine the probability of hit by a given threat) and vulnerability (the extent of system degradation after having been subjected to combat threats). A balanced survivability program includes the analysis of survivability with respect to all anticipated threats, trade-off studies, cost/benefit analyses to determine the best mixture of survivability enhancement techniques, and a T&E program to measure and evaluate performance. In evaluating proposed design features that bear on survivability, the PM and his staff should realize that high survivability is, in effect, a force multiplier.

Congress and the public have increasingly taken the DOD to task for developing sophisticated and expensive systems that do not have reduced susceptibility and are vulnerable to "cheap kills" or to particular threats. DODI 5000.2 requires that survivability be considered in acquisition planning under both mission analysis and design considerations. The Justification for Major System New Start/Operational Requirement/Required Operational Capability (JMSNS/OR/ROC) must include an explicit threat statement. Survivability goals and thresholds must be given in the milestone review documentation (MRD). System vulnerability to detection, interference, and attack, and the program actions chosen to minimize these vulnerabilities, must be discussed. Both nuclear and non-nuclear survivability and endurance information are required. DODD 5000.3 requires that survivability/vulnerability problems and their solutions be identified in DT&E and that survivability/vulnerability be evaluated as part of operation effectiveness in OT&E. NAVMATINST 3900.16 requires that survivability requirements be included during the earliest conceptual formulations of mission essential weapon systems (MEWS), and that the requirements be addressed as a major issue in the MRD beginning with Milestone I. Thus, survivability against the full spectrum of warfare threats must be treated as a design parameter for all mission-essential systems. This treatment must take into consideration the protection of personnel. Each system must be periodically re-evaluated during its operational life cycle to determine whether survivability modifications are warranted.

Figure 4-18, adapted from MIL-STD-2072, indicates some of the life-cycle survivability requirements. MIL-STD-2072, although written for aircraft systems, contains advice applicable to ship and submarine systems as well.

Mission and Threat Requirements

The criteria for combat mission effectiveness and the description of typical combat scenarios will be provided by OPNAV. A description of the specific threats to be considered will be provided by the Naval Intelligence Command via OPNAV and should include the full threat-spectrum likely to be encountered including electronic, and chemical, biological, and radiation (nuclear) (CBR) threats. Due to the dynamic nature of the evolving threat, the PM should consider a Preplanned Product Improvement Program (P³I) to enhance survivability against new threats.

Weapons Effects

The system designers must consider the effects of all weapons likely to be encountered during combat. These effects include blast overpressure, ionizing and thermal radiation, underwater shock, electromagnetic pulse (EMP) and fallout from nuclear weapons, high-velocity fragments, shaped charge and blast effects from conventional weapons, electromagnetic interference of both a "spoofing" and destructive nature, high-energy lasers, particle beam weapons, and chemical and biological agents.

RF Susceptibility

The effects of RF susceptibility vary from complete destruction of a system to diminished performance of a system due to friendly electromagnetic interference (EMI) or enemy electronic countermeasures (ECM). RF susceptibility is increasing in severity due to the increased reliance on electronics, the use of miniaturization and microminiaturization of electronic components, and the exposure of system to higher RF flux densities.

EMI can be broken down into two classes: sensitivity degradation and signal distortion. The first interferes with the basic detection processes of the system and is usually associated with noise or noise-like interference. The second type introduces errors or accuracy degradation in one or another of the system outputs. The second is more insidious and less easily detected. Both forms may result in catastrophic effects, e.g., the initiation of an ordnance firing train on a carrier deck, the obscuration of a threat's approach, or the alteration of a compass heading.

RF susceptibility must be countered by proper system design to prevent entry of spurious signals. This requires an acute awareness of the problem by the product engineer or designer. Reducing RF susceptibility required significant effort throughout the period of design evolution, including the deliberate T&E of the system for such susceptibility.

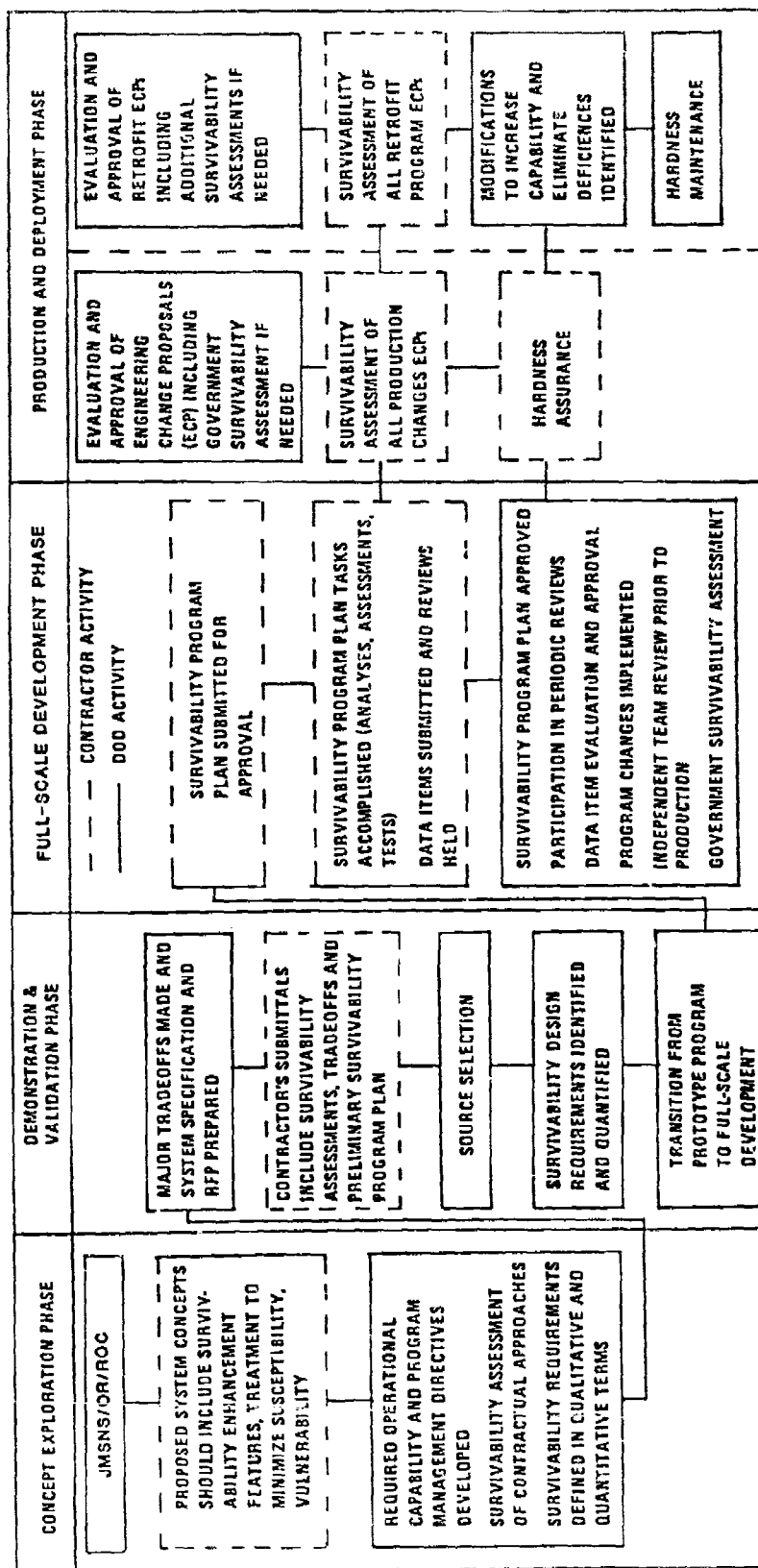


FIGURE 4-18. Life-Cycle Survivability Requirements.

Electronic Counter-Countermeasures (ECCM)

DODD C-4600.3, Electronic Counter - Countermeasures (ECCM) Policy states that "the sponsoring agency, in collaboration with the user and developer, will document and support a recommendation for an appropriate level of ECCM protection" for all electronic systems. "The minimum goals for ECCM protection will be to provide capabilities comparable to the protection afforded the complete weapon system... (and) the developer will initiate the appropriate action to ensure that adequate threats signal simulators are available to support test and evaluation..."

Countermeasures

System designers must consider both active and passive methods for interfering with an enemy's intelligence gathering, platform, and weapon sensors and thus reduce his ability to deliver weapons to the system. Countermeasures will include such diverse techniques as camouflage, obscuration devices (smokes and aerosols), chaff, decoys, jammers, and electronic support measures for the detection of threats.

System Signal reduction. One of the most effective means of increasing a system's survivability is by reducing its susceptibility to detection and targeting. Signature reduction - the reduction of radar cross section, infrared radiation, acoustic and visual signatures, as well as other emissions both intended and unintended - reduces the enemy's ability to determine the presence or location of a system or to guide his weapons to it, and increases the effectiveness of countermeasures.

Vulnerability Reduction

Many techniques and disciplines can be used to enhance survivability of mission-essential systems and subsystems, and may apply to platform design, to system-subsystem-component design, to personnel, or to any combination of these, depending on the threat. Certain techniques are basic to survivability, such as choice of materials and components; their location, shielding, component arrangements, redundancy, and re-configuration after damage. Different threats require different design approaches. Biological and chemical threats require design of shipboard-collective protection, decontamination, and washdown systems, plus clothing and prophylaxis for shipboard personnel. Protective clothing and equipment are required for aircrews. Nuclear weapon's effects will require shock hardening of sea systems to underwater shock, electromagnetic pulse protection of platforms and systems, design of electronic equipment to protect it from ionizing radiation, and design of ship superstructure and exposed equipment to provide protection from blast overpressure and thermal radiation.

The threats of conventional weapons are blast, fragments, shaped charges, and missiles and their debris. In addition to basic survivability techniques, equipments, ordnance, and systems should be designed for damage tolerance. Harden features, such as armor, may be appropriate. In some cases the backfit of hardening features may be required

when no other solution is possible. The costs of design against each threat are not necessarily additive, because design features provide protection against more than one threat. Skillful design and integration of subsystems into the platform will provide maximum survivability at minimum cost.

Warfare engagements are expected to be of increasingly shorter duration and involve the exchange of sophisticated and devastating weapons. Aircraft are being designed for sustainability (operating of systems at a reduced level of capability rather than catastrophic failure after damage); ability to return to the carrier or base after damage; and rapid battle damage repairability. Ships are designed for reconfiguration of propulsion and generation of electrical power after damage. Procedures have been developed for assessing the status of combat systems after damage and reconfiguration of systems for maximum combat capability.

Personnel Protection

The protection of personnel against primary and secondary weapons effects is an extremely important aspect of survivability. This protection includes the selective use of armor, CBR filter, protective clothing, and decontamination equipment.

Survivability Program Assistance

Assistance in setting up a survivability program may be obtained from NAVMAT-08D, NAVAIR-5184 (the Navy Air Combat Survivability Office), NAVLEX-51024, and NAVSEA-322 (Ship Survivability Division). Technical assistance is available from NADC and NWC for aircraft, aircrews and aircraft systems; NSWC and DTNSRDC for ship structure and hull, mechanical and electrical (HME) systems; DTNSRDC for submarines; NOSC for command, control, and communication systems; NSWC for nuclear weapons effects; NSWC and NWC for combat systems; NRL for fire fighting; NSWC for biological and chemical defense; NSWC and DTNSRDC for ship radar cross section and infrared signature reduction; NADC for aircraft radar cross section reduction; and NWC for aircraft infrared signature reduction.

NAVY STANDARDIZATION

The PM should make maximum use of existing Navy standard hardware and software. Use of standard materials and procedures lead to LCC benefits, higher reliability, and established logistic support base, simplified training, and proper documentation. System contractors will often try to convince the PM that their particular product has technical advantages over the standard hardware because it has been optimized for the particular system that is being acquired. If the new product is utilized, however, the program must contend with an unknown entity and its attendant negative impact on the ILS for the entire system.

Examples of Navy standardization policy are the requirements governing the use of tactical embedded computers and standard equipment modules (SEM). Utilization of a non-standard tactical computer, or electronic modules in other than SEM format, requires prior approval of CNM (MAT-08). The Navy standard computer include the UYK-7, UYK-20, AYK-14 and UYS-1. Under development are the UYK-44, a replacement for the UYK-20; UYK-43, a replacement for the UYK-7, and the enhanced modular signal processor (EMSP), a replacement for the UYS-1. There are other standard computer peripherals such as disk files, displays, magnetic tape units, as well as support software and tools. The PM should coordinate with Headquarters, NAVMAT (MAT-08Y) to obtain additional information on CNM policy in this area.

The optimum level of standardization for a program can be achieved with the assistance of the Defense Logistics Agency (DLA) through their Military Parts Control Advisory Groups located at the Defense Electronics Supply Center in Dayton, Ohio, the Defense Industrial Supply Center in Philadelphia, Pennsylvania, the Defense General Supply Center in Richmond, Virginia, and the Defense Construction Supply Center in Columbus, Ohio. DLA engineers provide the Navy with advice and recommendations on the selection and use of DOD-preferred and standard parts during the design phase of the acquisition process. Non-standard parts submitted for evaluation are considered for suitability for government re-procurement and as potential candidates for standardization. In conjunction with the parts advisory service, DLA engineers may prepare or cause to be prepared, military specifications or standards needed to procure and standardize new parts. Final authority for the selection and use of parts during design rests with the Navy. The PM will find the DLA a useful resource for helping contractors determine commonality of parts, assisting in selecting the latest preferred standard parts, interpreting specification requirements and determining applicability, modifying or recommending modification to existing military/industry specifications to meet the latest requirements, and clarifying parts control procedures and problems.

SAFETY

Safety is defined as that attribute of a system or operation that renders it free from conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property (adapted from paragraph 3.5 of MIL-STD 882A). It follows that for any program, the PM must concern himself with two aspects of system safety: (1) the safety of personnel, material, and facilities involved in the development, test, production, deliver, and installation of the system and (2) the safety of personnel, material, and facilities involved in and affected by the operation, storage, and maintenance of the system itself or its subsystems and components. Since safety is achieved in part through good design, the contractor must focus on safety at the earliest stages of concept development.

No system can be rendered completely free of hazard or made totally safe. MIL-STD 882A defines system safety as "the optimum degree of safety within the constraints of operational effectiveness, time, and cost, attained through specific application of system safety management

and engineering principles whereby hazard are identified and risk minimized throughout all phases of the system life cycle". System safety programs must be conceived/operated with the end in view of first identifying hazards; then minimizing the risk associated with those hazards.

System safety engineering is a philosophy of resource management in which the identification and elimination or control of hazards is sought in an effort to reduce losses of men and equipment. DODI 5000.36, implemented by NAVMATINST 5100.6, requires organized use of system safety engineering and system safety management for each major DOD system acquisition.

By early consideration of system safety engineering, potential hazards can be identified and minimized through design changes at minimal cost. If hazards are not discovered until after the design is completed, minimization of the associated risk is often prohibitively costly in terms of time and dollars. If system safety is omitted from consideration as a design attribute, the PM will encounter difficulty in obtaining a safety sign-off for procurement, a determination of operational suitability, or approval for full production (AFP).

The Weapons System Explosive Safety Review Board (WSESRB) was established by the CNM (NAVMATINST 8020.1) as a part of the naval explosives safety program. The Board's scope of cognizance includes the review of all ammunition, explosive devices, weapons, weapon systems (including pyrotechnics and chemical or biological agents), handling hardware, stowage factors, processing, test, and checkout equipment, to determine the nature and extent of the mechanical, thermal, chemical, electrical and electromagnetic radiation hazards that the systems and subsystems present to men and material. The WSESRB has responsibility for the review of designs, analysis, test results, operational and logistic plans, and all explosive safety documentation, procedures, precautions, instructions, and training related to weapon systems, subsystems, and/or explosive ordnance component development.

For systems using explosive, pyrotechnics, or other hazardous materials, WSESRB reviews are mandatory prior to advancing to each phase of development, technical evaluation, operational evaluation, and AFP. After completion of the review, the Board will either recommend advancement to the next phase of the acquisition cycle or will make appropriate recommendations, from an explosives safety viewpoint, on the desirability of further development or change before advancing to either the next state of development or introduction to the Fleet. Corrective action must be taken before final Board approval.

System safety engineering support exists at all levels of the Navy organization. The various Commands usually have identified a principal for safety who is familiar with the various system safety requirements at that particular level of the organization. The principal for safety can direct the PM to ensure proper safety involvements. NAVMAT-04F, NAVAIR-09E, and NAVSEA-04H are examples of safety support codes.

PRODUCIBILITY

The Navy is placing renewed emphasis on reducing acquisition costs. Producibility is the discipline of reducing production costs while maintaining quality. There are several factors that contribute to the current concern with producibility. First, the technology in manufacturing processes and materials is growing rapidly and it requires concentrated effort to stay abreast of the state-of-the-art in materials, manufacturing processes, and control. Second, technical data packages (TDPs) have in the past been almost void of meaningful reviews that address producibility. Such reviews would include inspectability, which is one of the key elements of a producibility review. Third, production-support engineers are kept extremely busy putting out brush fires that should have been resolved in the early design stages.

DODD 5000.34, Defense Production Management, states that "each DOD component having authority and responsibility for acquisition of major systems shall establish a focal point responsible for policy and procedures to implement the provision of this directive and shall coordinate production management activities". The Navy is charged with the responsibility for "assuring that consideration is given to the producibility of proposed concepts during the D&V Phase".

Producibility is defined as the inherent design attribute that enables a configuration item to meet all of its performance objectives within the design constraints, and yet to be produced in the shortest total time, at the lowest cost, with the most readily available materials, using the most advantages processes and assembly methods. Note that the performance objective (including R&M) must not be compromised or adversely affected by factors introduced to maximize producibility. The design which meets the performance objectives, and yet can be produced in the simplest and most economical manner, will have the maximum practical producibility. Product and production engineers must follow cost-effective design practices during all phases of the acquisition process. From the outset of the program they must seek:

1. To maximize:
 - a. Simplicity of the design
 - b. Standardization of materials and components
 - c. Potential industrial production capability
 - d. Repeatability of processes employed
 - e. Inspectability of the product
 - f. Provisions for industrial safety in production
2. To minimize:
 - a. Use of critical (strategic) materials
 - b. Need for special production tooling and special test systems
 - c. Use of critical processes
 - d. Need for high skill levels by production personnel
 - e. Introduction of design changes in production
 - f. Use of limited availability items and processes
 - g. Use of proprietary items

Production engineers must be brought into the picture as soon as the first drawings are presented if the producibility attribute is to be achieved to an acceptable degree. A strategy for achieving a high degree of producibility should be an integral part of the documented acquisition strategy.

In summary, producibility is an inherent in the design. Most of the producibility attribute and hence most of the production costs are locked in during the Concept Exploration and D&V Phases. To achieve an acceptable degree of producibility, the PM must employ a systematic approach from the beginning of the program. To do so will pay great dividends through the reduction of costly delays during the FSD and early Production Phases and reduction of the need for expensive modification during the Production and Deployment Phase.

DOCUMENTATION

The product of a development program is a documentation package. Documentation can be grouped into three categories as follows:

1. Program documentation to justify, establish, and report progress on the program to higher management echelons
2. Management documentation to facilitate management of the program
3. Product documentation to describe the product and enable its development, procurement, inspection, acceptance, logistic support, and use.

Documentation requirements should be limited to those that are essential to the acquisition process.

The requirements for documentation items in the first category is mandatory. Their format, content, detail, and timing have been specified by DOD, SECNAV, OPNAV, CNM, and SYSCOM directives. The PM and his staff should consult the basic directive for a discussion of the style, format, and content for each.

The second category consists of the documentation required by the PM from contractors, in-house support groups, and his own staff. This helps the PM to provide the documentation required by higher authority and to justify and manage the program's activities. Some of the documentation will be mandated by NAVMAT or the parent SYSCOM and some by the PM himself.

The third category consists of the documentation necessary to permit manufacture of the system in question by a qualified industrial concern, inspection, and acceptance into the inventory by government inspection services, operation, and maintenance by the using Commands. Examples of the types of documentation normally found in this third category include production drawings and specifications, operating manuals, training manuals, maintenance handbooks, logistics plans, and parts lists. Various aspects of product documentation are discussed in

this Guide under the critical topics "Specifications", "Configuration Management" and "Contracting".

In the area of documentation not mandated by higher authority, the PM should rigorously evaluate each item being requested to ensure that it is essential, does not put an unacceptable burden on the preparing group or individual and, most important, that it does not call for information that is available in another form elsewhere. A suggested method for evaluating the essentiality of such documentation is to assign each item an arbitrary essentiality index. Then by estimating the cost in manpower and time to produce the item and weighing it against the essentiality rating, a cost-effectiveness rating can be arrived at.

SPECIFICATIONS

The system, development, and product specifications are among the most important of the document produced during the acquisition process. A specification is defined as a document, intended primarily for use in procurement, that accurately describes the essential technical requirements for items, materials, or services, including the procedures for determining that the requirements have been met (DODD 4120.3).

System and equipment specifications, when invoked by a contract, become a part of that contract and as such are legally enforceable. When disagreements between the government and a contractor develop, the issues will be resolved on the basis of what the specifications say, and not what they are intended to say. The PM must realize that the preparation, review, and maintenance of the program's specification requirements are activities worthy of the most competent members of the PMO and need the undivided attention of one or more people who are skilled in specification matter.

At the first writing, specifications seldom achieve the clarity of expression required to make them unambiguous. Moreover, they often contain requirements and values that were intuitively arrived at and are subsequently shown to be either unnecessarily restrictive or not restrictive enough. Specifications are living documents that must be reviewed, maintained, changed, and updated to eliminate ambiguities, errors, and unnecessary requirements, and to reflect the current realities of total program requirements.

As system complexity grows and the number of recognizable subsystems increases, a program manager will find it helpful to have his configuration specialists prepare a specification tree. The tree should contain a rank and order listing of all system, subsystem, equipment assembly, and component specifications that will be required to support the acquisition process and the spare parts procurement program. The tree should also show, for each specification listed, the program team action engineer (the team member responsible for the specifications preparation, review and approval), the date by which approval is required, and the current status. Status reviews of the specification tree should be scheduled by the program office as necessary.

The specifications established during the acquisition process differ for each of the phases. However, they should all state only the actual minimum needs of the government and describe the supplies and services in such a manner as to encourage competition among qualified suppliers. They should avoid restrictive requirements that might inhibit the submission of acceptable proposals. As the program moves forward, the specifications will become progressively more detailed (Figure 4-19).

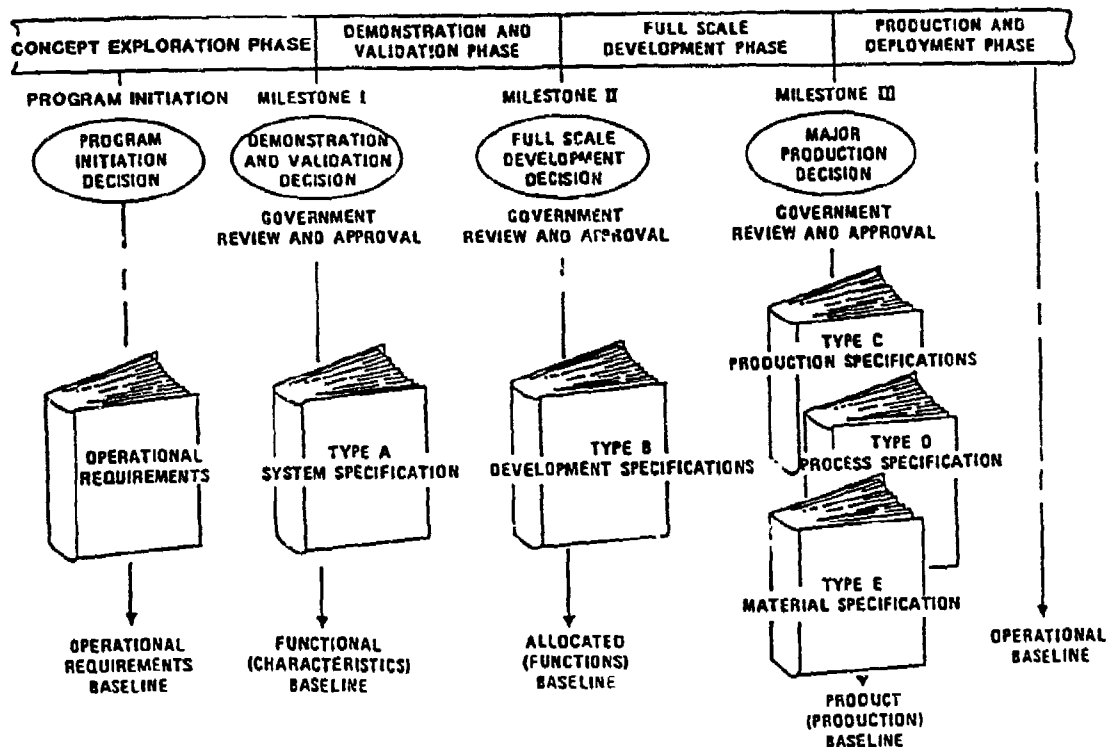


FIGURE 4-19. Progressive Definition of System Specifications.

Concept Exploration Phase

The specification for the initial solicitation of system concepts is little more than a copy of the JMSNS/OR/ROC itself. Any additional material provided in the solicitation for system design concepts should assiduously avoid specification in terms of equipment, but rather, should explain the need in mission or capability terms, schedule objectives and constraints, project cost objectives, and operational constraints.

D&V Phase

At the conclusion of the Concept Exploration Phase, each contractor that has been selected to participate in the D&V Phase should have evolved and submitted a system specification. This is done in collaboration with the PMO. The system specification is defined in MIL-STD 480 as "a document which states the technical and mission requirements for a system as an entity, allocates requirements to functional areas (or configuration items) and defines the interfaces among the functional areas". The D&V Phase system specification developed during the Concept Exploration Phase should have avoided all details that could later inhibit the construction of critical subsystems, equipment, and components, or the demonstration of the concept's technological feasibility. It is this system specification that establishes the functional baseline configuration for a proposed system. The system specification will constrain the contractor's efforts and will be refined during the D&V Phase.

FSD Phase

By the end of the D&V Phase, the contractors, in collaboration with the program system engineer, will have refined their system specifications. The specifications will update the system performance and compatibility requirements and reflect the current definition of the system and the allocation of requirements to the several functional areas or configuration items. In addition, each competing contractor should have submitted a series of development specifications. Such a specification is defined in MIL-STD 480 as "a document applicable to an item below the system level which states performance, interface, and other technical requirements in sufficient detail to permit its design, engineering for service use, and evaluation". The update system specification and the series of development specifications constitute the Allocated Baseline Configuration that will constrain contractor efforts during the FSD Phase. The specifications should not contain a degree of detail that would inhibit the important trade-off studies and design evolution process vital to this phase.

Production and Deployment Phase

By the time the FSD Phase has been concluded, the contractor(s), in close collaboration with the PMO, should have provided a final update of the system specification and a series of production specifications. A product specification is defined in MIL-STD 480 as "a document applicable to a production item below the system level which states item characteristics in a manner suitable for procurement, production, and acceptance". The production specifications should provide all the detail necessary to permit economical procurement of functional elements that, when assembled into a system, will perform as a system in accordance with the current system specification. These production specifications consist of two distinct types, the function specification (performance) and the fabrication specification (design).

The technical data package that represents the formally accepted first edition (drawings and specifications) required to produce, test, and accept the configuration item is evolved during the Production and Deployment Phase. This package constitutes the Product Baseline Configuration (see par. 10.3, MIL-STD 480) of the system and will be contractually invoked for any procurements of the system, or its parts, for service use.

CONFIGURATION MANAGEMENT

Configuration management is a discipline applying administrative direction and surveillance to (1) identify and document the functional and physical characteristics of a configuration item, (2) control changes to those characteristics, and (3) record and report the change, process, and implementation status. The purpose of configuration management is to prevent engineering anarchy and permit orderly development, recording, reproduction, and support of a system. Configuration management is accomplished through the Functional, Allocated, and Product Baseline Configurations. Each of these is identified by a document or set of documents.

The FUNCTIONAL BASELINE CONFIGURATION is defined in the initial, approved system specification. It establishes the requirements for the system as an entity, allocates those requirements to functional areas, and defines the interfaces between and among the functional areas. This baseline is invoked at the initiation of the D&V Phase.

The ALLOCATED BASELINE CONFIGURATION is defined in a set of development specifications. It establishes the performance, interface, and other technical requirements for configuration items identified in the system specification's functional areas. The development specifications and the system specification constitute the baseline at the initiation of the FSD Phase.

The PRODUCT BASELINE CONFIGURATION consists of a set of product specifications for the identified configuration items in the system specification's functional areas. The product specifications will consist of either or both the function or performance specifications. These establish performance, interface, and interchangeability requirements and characteristics (form, fit, and function). Product specifications also include fabrication or design specifications and drawings that establish detailed product descriptions (down to the lowest level of interchangeability) in the form of performance requirements, and the test and inspection required to assure proper fabrication, adjustment, assembly, and acceptance. These drawings and specifications and the currently approved system specification constitute the baseline for the Production and Deployment Phase. Once a baseline is established it may not be changed except by formal change action. Procedures for these baseline changes are covered in MIL-STD 480.

At no point is a system's documentation package finally and permanently fixed. The lessons learned from full-scale production will have an impact on the design package, as will feedback from the Fleet after the system is developed. A configuration control program is necessary

to accommodate changes to the design package.

Configuration management is intended to control configuration changes, not to prevent them. The formalities of configuration control should not inhibit the accomplishment of necessary changes of force bypassing of the change control procedures.

During the design evolution in the Concept Exploration, D&V and FSD Phases, rapid, controlled changes are necessary. Change control procedures for these phases should be implemented and administered at the program level. Implementation and administration should shift to the Change Control Board (CCB) of the procuring SYSCOM once the product baseline configuration is established (usually when a contract is entered into that includes items for service use). Total control of the emerging product baseline configuration should be taken over by the government not later than the start of formal TECHEVAL, Board of Inspection and Survey (BIS) trials, or OPEVAL, whichever come first. Changes should be allowed only when it can be justified by cost-effectiveness or for the correction of problems or failure.

Effective control procedures will hopefully eliminate the nice-but-not-necessary changes that keep designs in a state of turmoil, lead to litigation, and unnecessarily burden the logistic support system and training program. Nevertheless, configuration control should not become so strict and burdensome as to arrest or inhibit the design maturation process. Change will always be necessary to enhance design attributes such as reliability, maintainability, and producibility; to correct latent design deficiencies discovered by ongoing follow-on test and evaluation (FOT&E) and production acceptance test and evaluation (PAT&E) programs; to embrace applicable new technology, and to accommodate changing tactics and new threats. So long as changes are carefully controlled and accounted for in the management system, they can significantly enhance the utility of the system.

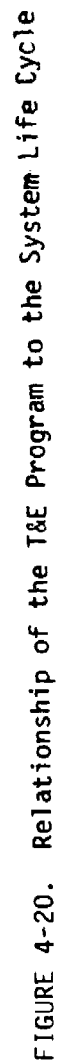
TEST AND EVALUATION (T&E)

Every system developed or used by the Navy must be tested many times during its life cycle. Tests are undertaken to demonstrate feasibility, address areas of risk, aid in the determination of design alternatives and trade-offs necessary to best achieve project objectives, and to determine the performance of items under controlled conditions that approximate the expected operational conditions.

Evaluation of the data obtained from these tests forms the basis for redesign action and a host of other management decisions that govern the advance of a program through the acquisition process. The relationship of the overall T&E program to the acquisition process is shown in Figure 4-20.

Requirements

Navy system acquisition policy emphasizes that demonstration performance is the pacing requirement of acquisition programs. DODD 5000.3



establishes policy for the conduct of T&E by the military departments in the acquisition of defense systems. OPNAVINST 3960.10B implements DODD 5000.3 and establishes Navy policy for T&E. This is amplified by OPNAVNOTE 3960 of 30 Mar 1983, NAVMATINSTs 3960.6, 3960.7, and 3960.8. These documents regulate three types of testing: DT&E, OT&E and production acceptance test and evaluation (PAT&E); and establish selection policy for Land-Based Test Sites.

Development Test and Evaluation (DT&E). DT&E must be addressed early in the program to bring to light flaws in design, performance, or construction techniques. DT&E is a tool for pinpointing problem areas in their early stages. Whenever possible, simulation and laboratory testing should be conducted prior to the expensive field tests. As well as being cost effective, this procedure also permits more effective and efficient field tests. Environmental testing, reliability testing, and testing of breadboard parts and components are part of the design process. These tests permit the designer to catch deficiencies at a correctable stage, aid in the selection of conceptual and design alternatives, and determine the extent to which technical and operational requirements are being met as development proceeds.

In the early acquisition phases, DT&E is conducted by design activities and the participating laboratories and centers. As the design evolves, SYSCOM-sponsored test activities are called on to conduct T&E prescribed by the PM and the parent Command. TECHEVAL is conducted to enable the PM and his team to independently assess the status of the emerging design and ultimately, to establish a basis for certification of readiness for OPEVAL. The final DT&E effort is in support of the modifications undertaken to correct design deficiencies revealed by ongoing OT&E and PAT&E programs.

Operational Test and Evaluation (OT&E). The OT&E program is conducted by the Operational Test and Evaluation Force (OPTEVFOR), an independent Navy test activity that is chartered by CNO. In the concept formulation period, OPTEVFOR may lend assistance to OPNAV and the developing agencies in their research program and in efforts to formulate statements of mission need and to conceptualize approaches to meet those needs. In the initial OT&E program, OPTEVFOR assesses, on a continuing basis, the prospects for operational viability of system concepts proposed for meeting an operational need and the operational suitability of those concepts as they are being demonstrated, validated, and developed for service use. Finally, in the formal OPEVAL portion of the program, OPTEVFOR assesses the degree of operational effectiveness and operational suitability achieved by the finished design and develops tactics for the system's deployment. In OPEVAL, OPTEVFOR exercises the system (or equipment) in conditions that simulate as closely as possible the expected operational environment. This environment includes operation and maintenance by Fleet-type personnel, test scenarios in which both forces (friendly and enemy) employ realistic tactics, and forces that fight back. The data, findings, and recommendations from the OT&E program are used in the milestone review and decision process and form the basis for CNO's AFP.

In the follow-on OT&E (FOT&E) program, OPTEVFOR may be required to complete testing deferred during OPEVAL, to verify correction of defici-

encies, to further develop tactical data and tactics for the system's employment, and to conduct any additional operational test that CNO may require.

Concurrency of DT&E and OT&E. The PM, after consultation with COMOPTEVFOR and with the approval of competent authority, may combine portions of DT&E and OT&E. This is most frequently done in the development of large, expensive systems or systems of which only a small number will be produced and fielded. Concurrency is encouraged because it can save significant amounts of time, test items, and money. Care must be taken in both the planning and conduct of these combined tests to ensure that both DT&E and OT&E purposes are served. Independent evaluation of the tests and a realistic operational environment (including operation and maintenance by Fleet-type personnel) during testing are mandatory for OT&E.

Production Acceptance T&E (PAT&E). The PAT&E program consists of the aggregate of T&E programs, sponsored and undertaken by contractors and the government, on production-for-service-use items. These programs are conducted both prior and subsequent to the items' delivery at the point of manufacture. PAT&E is intended to demonstrate whether or not the items (systems, subsystems, equipment, and components) comply with the requirements and specifications of the contract under which they were procured. PAT&E involves two different types of test programs. BIS trials proceed under the sponsorship and direction of the President of the Board of Inspection and Survey (PRESINSURV) and are conducted on ships and aircraft only. In the case of aircraft, only the first physical and functional equivalents of a model or type are subject to BIS trials; however, each and every ship delivered under a production contract is subject to the trials. Government acceptance tests (GATs) are conducted on items other than aircraft and ships. GATs include the factory acceptance tests (FATs) performed on each article and conducted under the supervision of the local plant representative, and the production monitoring tests (PMTs) conducted by SYSCOM-designated, independent, industrial or government activities.

Test and Evaluation Master Plan (TEMP)

The TEMP required by DODD 5000.3 and OPNAVINST 3960.10 is recognized throughout the test community as the controlling management document dealing with identification and integration of the objectives, responsibilities, methodologies, resources, and schedules for all aspects of T&E. The principal features of the TEMP are summarized in Figure 4-21. It is intended by OP-098 that the TEMP is to be a short, directive document, and that for ACAT III and IV programs, it is to be the program controlling document.

The TEMP results from collaboration between the PM, OPTEVFOR (or the Marine Corps Operational Test and Evaluation Activity (MCOTEA)) and, in the acquisition of ships and aircraft, the BIS. Inputs should also be solicited from the concept developer(s) as well as from reliability, maintainability, and QA personnel. The need for close and continued cooperation with OPTEVFOR in the development and execution of the TEMP is essential. As the Navy's independent T&E agency, OPTEVFOR determines the operational effectiveness and operational suitability of the developed system.

| | |
|-------------------|--|
| DEFINITION: | CONTROLLING T&E MANAGEMENT DOCUMENT FOR ACAT I, II, III AND IV PROGRAMS |
| FUNCTIONS: | TO CONTROL ACCOMPLISHMENT OF ADEQUATE T&E TO IDENTIFY NECESSARY T&E RESOURCES TO FACILITATE PLANNING, PROGRAMMING, BUDGETING TO MINIMIZE FLEET RDT&E SUPPORT REQUIREMENTS |
| RESPONSIBILITIES: | PROJECT MANAGER PREPARES IN COOPERATION WITH OPTEVFOR OPNAV APPROVES ALL TEMPS FOR ACAT II & III; REVIEWS AND FORWARDS TEMPS FOR ACAT I TO OSD SYSCOM COMMANDER AND COMOPTEVFOR APPROVES TEMPS FOR ACAT IVT; SYSCOM COMMANDER APPROVES TEMPS FOR ACAT IVM |
| CONTAINS: | SYSTEM DESCRIPTION/INTENDED OPERATIONAL MISSION CRITICAL T&E ISSUES, EXPANDED FOR DCP PROJECT OBJECTIVES AND THRESHOLDS FLEET TEST RESOURCES REQUIRED, STRIKE AIRCRAFT, RANGE, ETC. REQUIRED TECHNICAL AND OPERATIONAL CHARACTERISTICS PLANNED DT & OT INTEGRATED SCHEDULE FOR: CONTRACTOR DEMONSTRATIONS PRELIMINARY EVALUATIONS TECHEVAL/OPEVAL APPROVAL FOR FULL PRODUCTION REQUIRED "STANDARD" DT&E/OT&E/MILESTONES |

FIGURE 4-21. Principal Features of the TEMP.

The PM must prepare the TEMP early in the acquisition program. The TEMP will be signed by COMOPTEVFOR and the SYSCOM Commander (or CNM) and forwarded to the OPNAV sponsor, approved by OP-098 and distributed. The initial version, necessarily lacking in many planning details, must be approved by OPNAV prior to Milestone I. This approval constitutes CNO direction to conduct the T&E program and commits fleet support. For ACAT I and Joint Service programs the TEMP is forwarded to the Director Defense Test and Evaluation (DDT&E) in OSD for approval prior to each DSARC.

Test Planning

Comprehensive and objective testing is a goal of everyone involved in the acquisition process, and its achievement will be facilitated by careful, timely planning and budgeting. Test plans will be based directly on the TEMP by the development activity (for DT&E and development-activity-conducted PAT&E), by COMOPTEVFOR (for OT&E), and, when appropriate, by PRESINSURV (for BIS PAT&E). These test plans will be consistent with the TEMP and adequate to carry out its provisions.

Frequently overlooked among the inputs to T&E planning is the need to obtain accurate information on the anticipated threat-and-use environment. The development of a life profile, system-use profile, or factory-to-target sequence (see the critical topic entitled "Designing

for the Environment") in which inputs from the logistics and mission profiles are integrated is valuable in this regard.

For ACAT I programs, before DSARC II is reached, the PM, in coordination with the program team and the appropriate test agencies (e.g., OPTEVFOR), must ensure that:

1. Test objectives are established and understood
2. Test criteria are determined and understood
3. Test methods are defined and understood
4. Funds are allocated to support development of an adequate, simulated, threat-and-use environment with appropriate range-instrumentation and data processing capabilities.

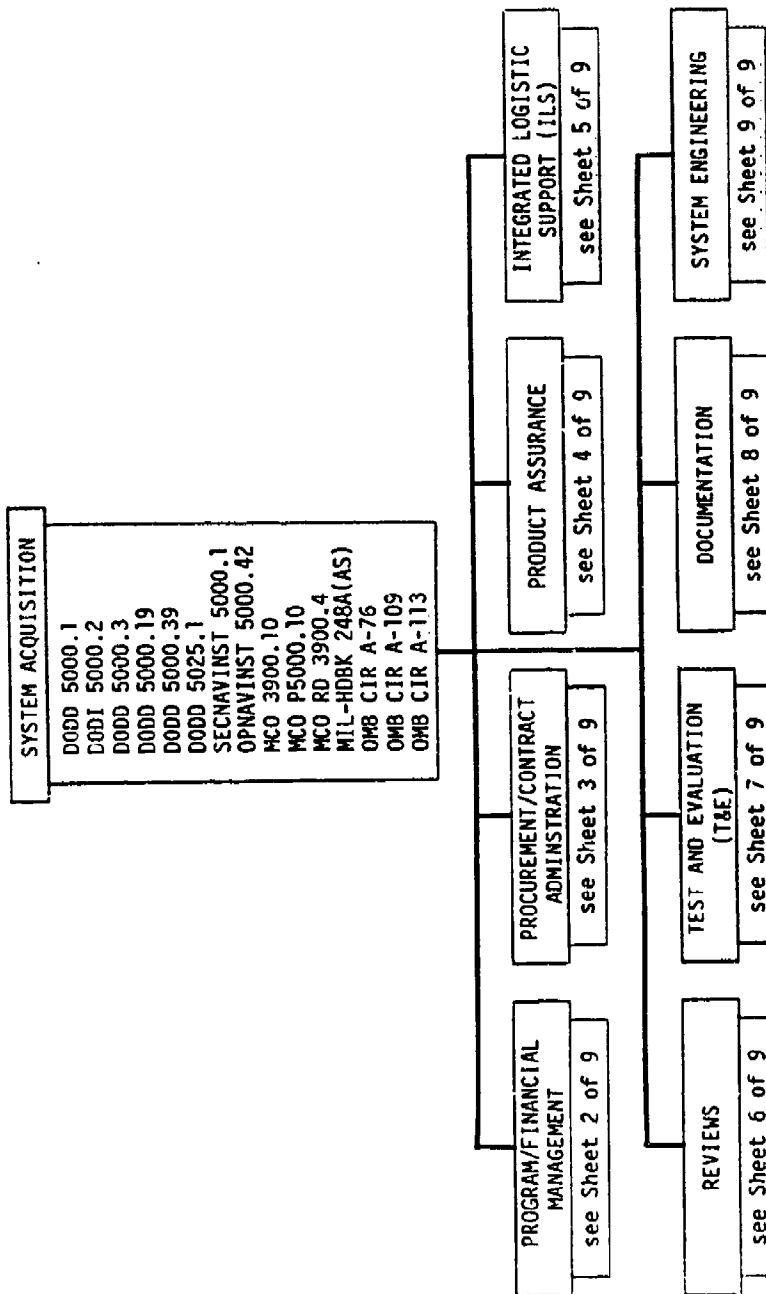
Joint Service Testing

Two types of joint service testing have emerged through usage. The first, not normally applied to an acquisition program, is usually joint T&E (JT&E). JT&E is OSD directed and partially funded, non-acquisition T&E structured to evaluate system operational or technical performance under realistic conditions with more than one service participating or with interrelated/interacting systems. JT&E is normally initiated and coordinated by DDT&E with one of the services delegated detailed management responsibility. For initial planning (prior to assignment of a lead service), OP-098 serves as the Navy point of contact with DDT&E on JT&E matters.

The second type of joint service testing, usually relating to system acquisition, is often called multi-service T&E (MST&E). MST&E is the T&E conducted jointly by two or more services for systems to be acquired by more than one service or for a service's system that has to interface with another service's equipment. It may include either or both DT&E and OT&E objectives.

When the Navy is the lead (executive) service, MST&E will be conducted as outlined in OPNAVINST 3960.10. When another service (or agency) is the lead, MST&E will be conducted in accordance with its T&E regulations and procedures.

Deviation from the T&E regulation of the lead service may be implemented by written agreement between the involved services. Also, tests conducted by a single service, usually done for its own unique requirement, will be conducted under its own regulations.



NOTE

For all instructions, orders, MIL-STDs, etc., the reader is cautioned to make sure that the latest version of the document is available, i.e., the highest letter designation or latest date.

FIGURE 4-22, Sheet 1 of 9. Controlling Document List.

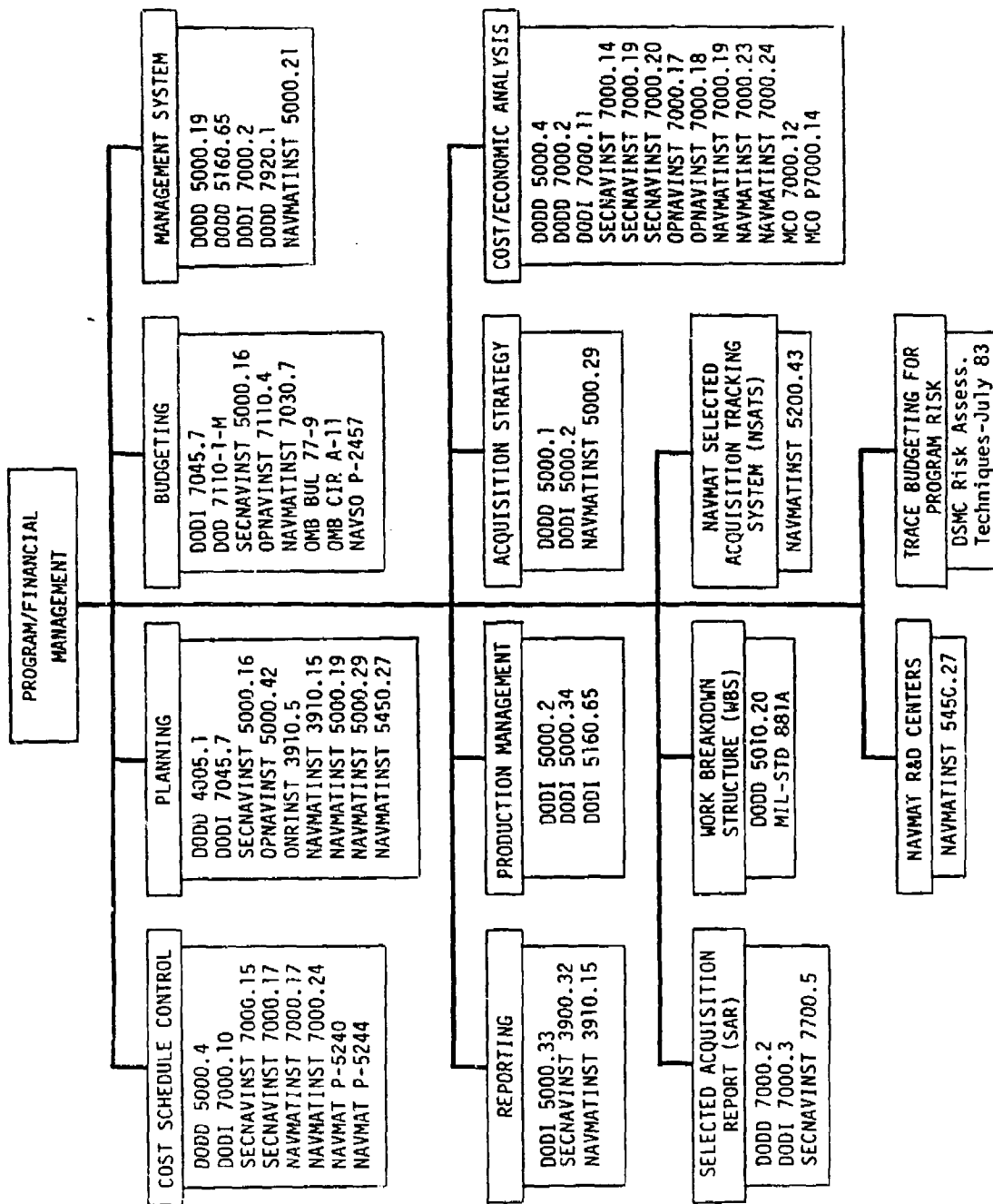


FIGURE 4-22, Sheet 2 of 9. Controlling Document List.

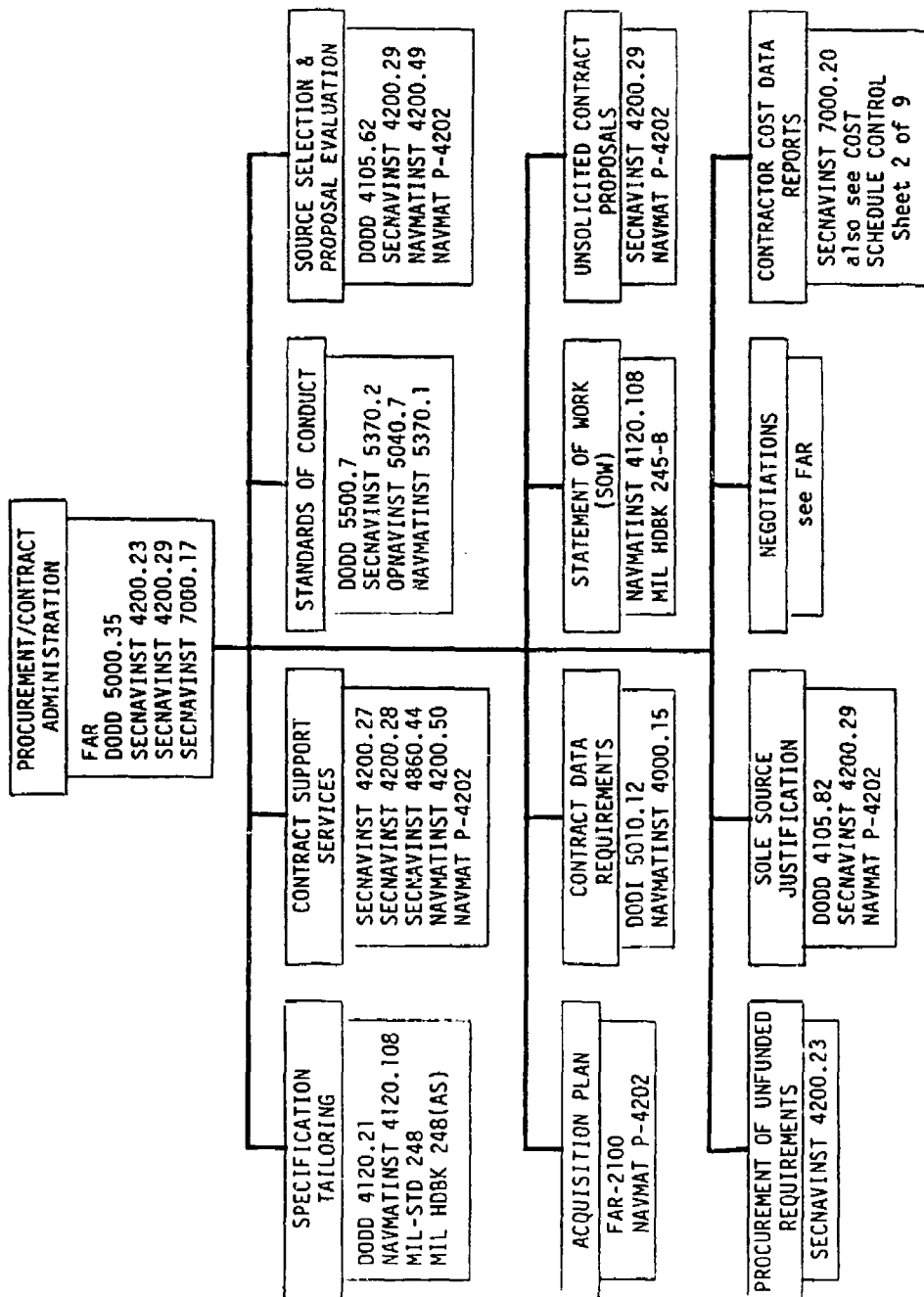


FIGURE 4-22, Sheet 3 of 9. Controlling Document List.

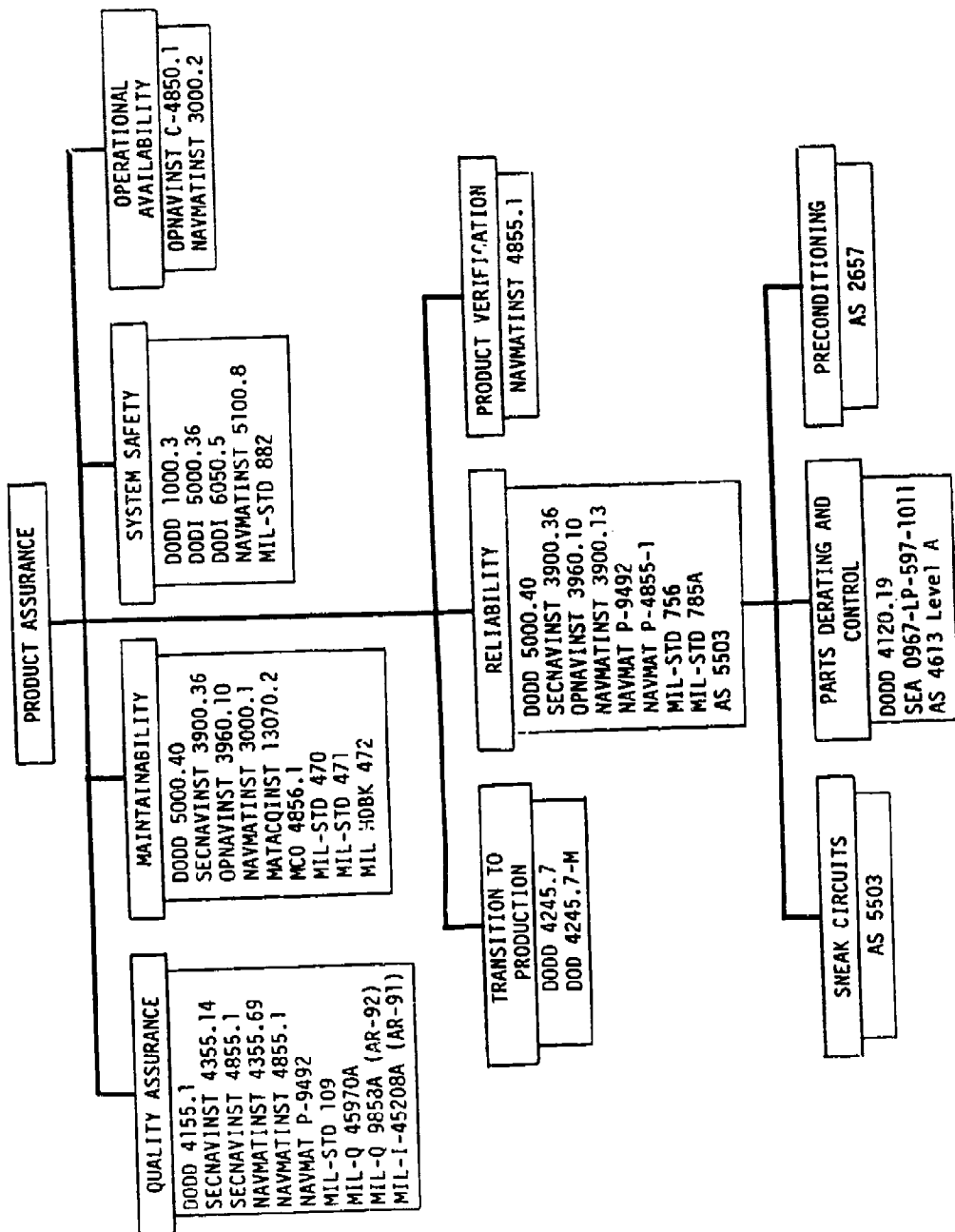


FIGURE 4-22, Sheet 4 of 9. Controlling Document List.

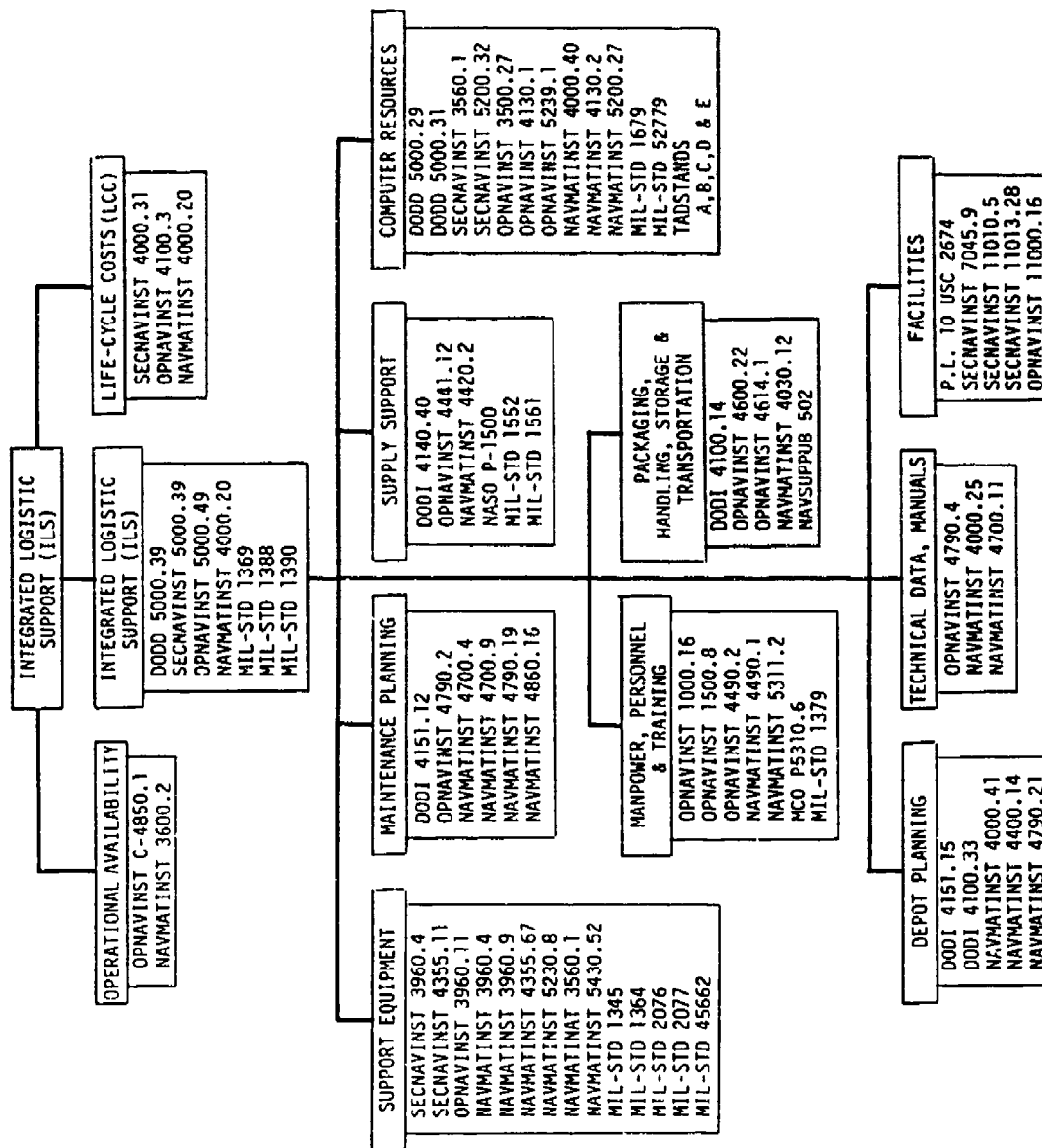


FIGURE 4-22, Sheet 5 of 9. Controlling Document List.

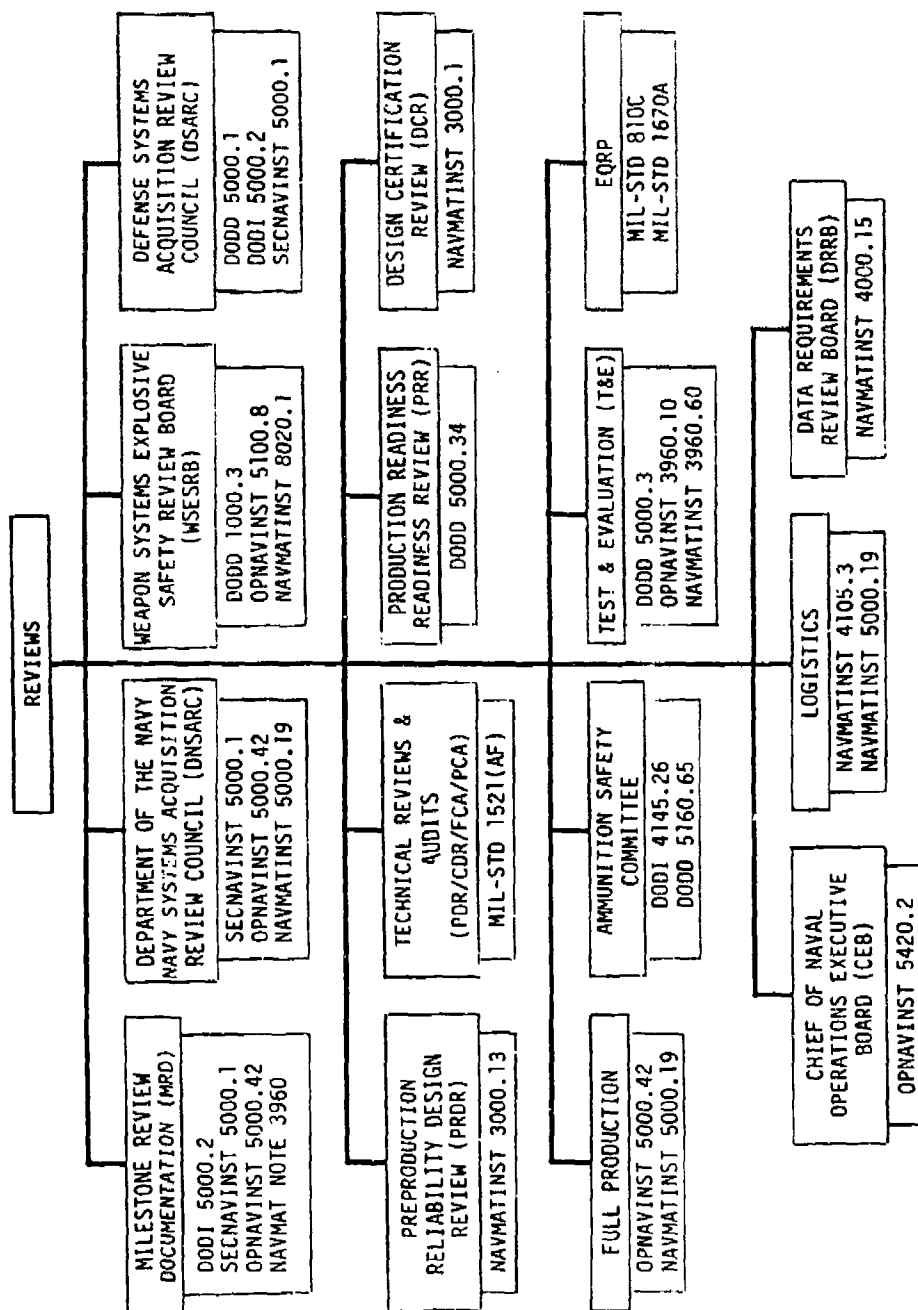


FIGURE 4-22, Sheet 6 of 9. Controlling Document List.

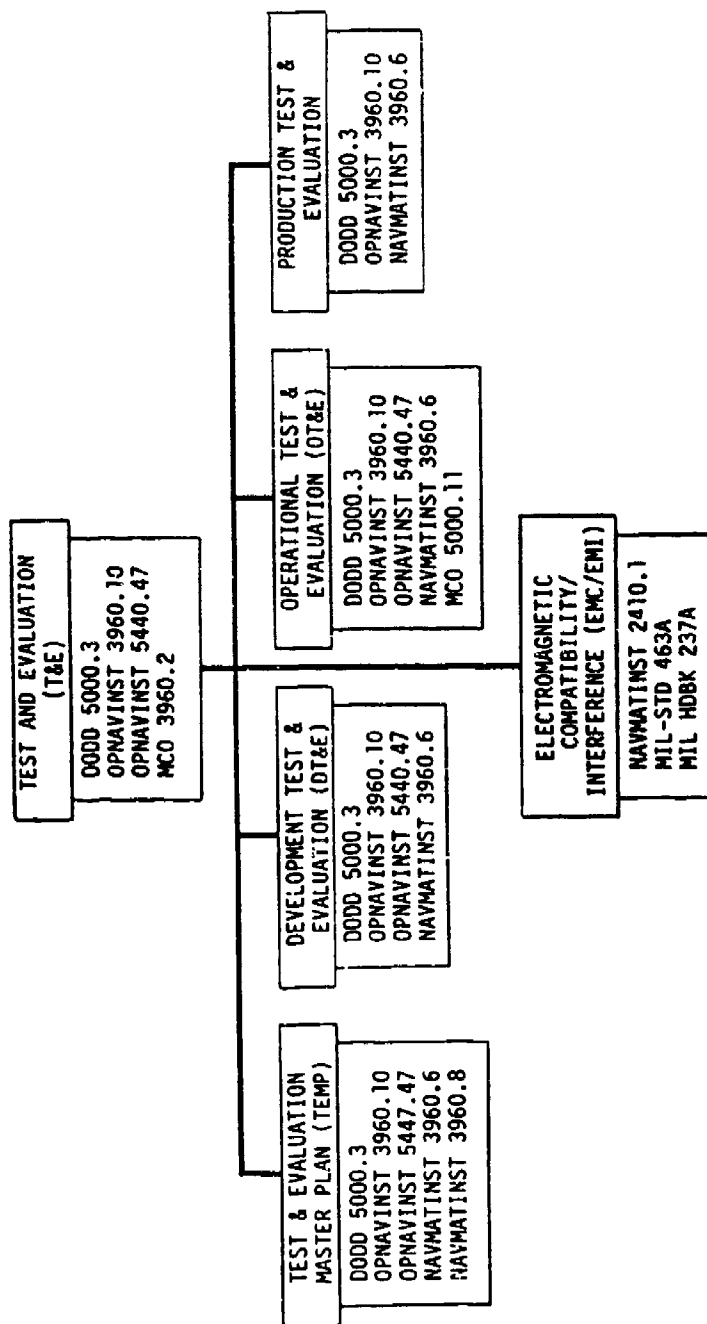


FIGURE 4-22, Sheet 7 of 9. Controlling Document List.

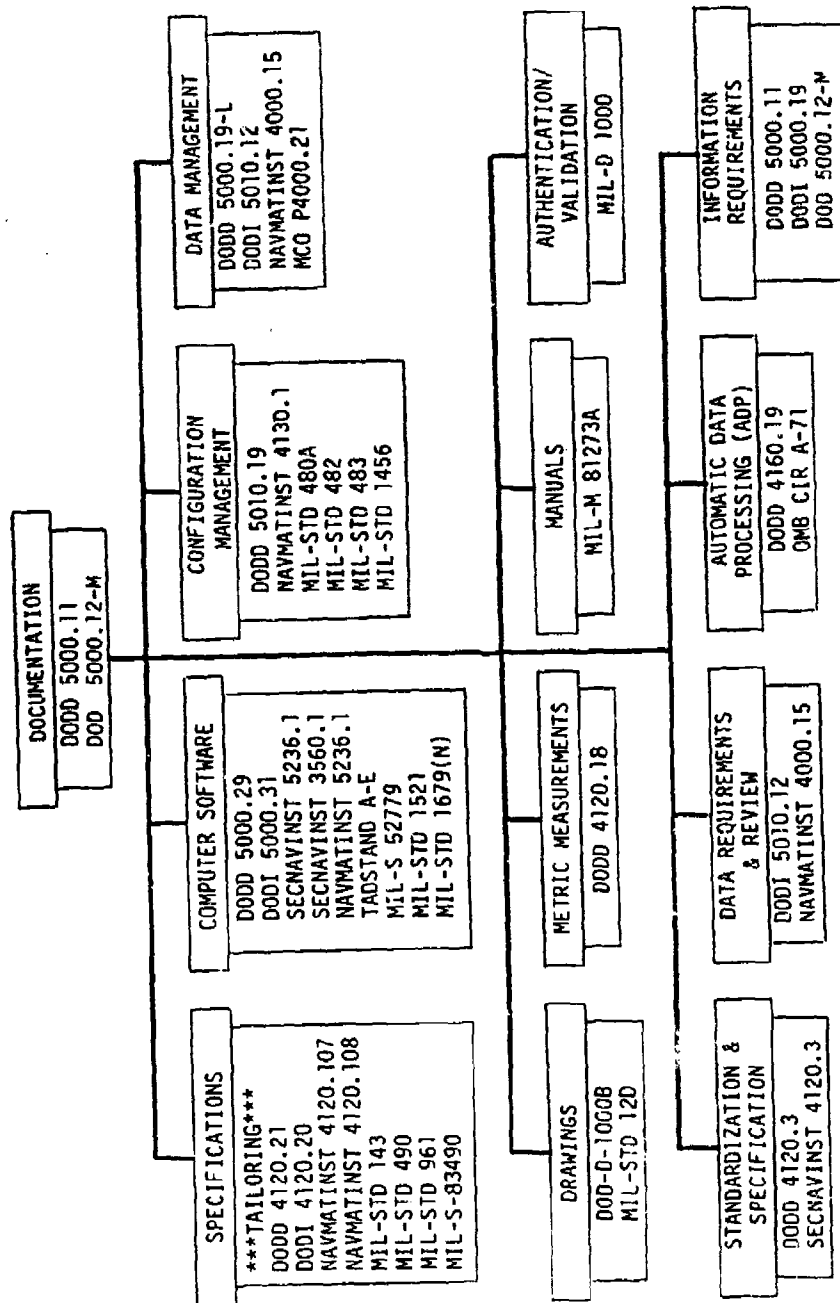


FIGURE 4-22, Sheet 8 of 9. Controlling Document List.

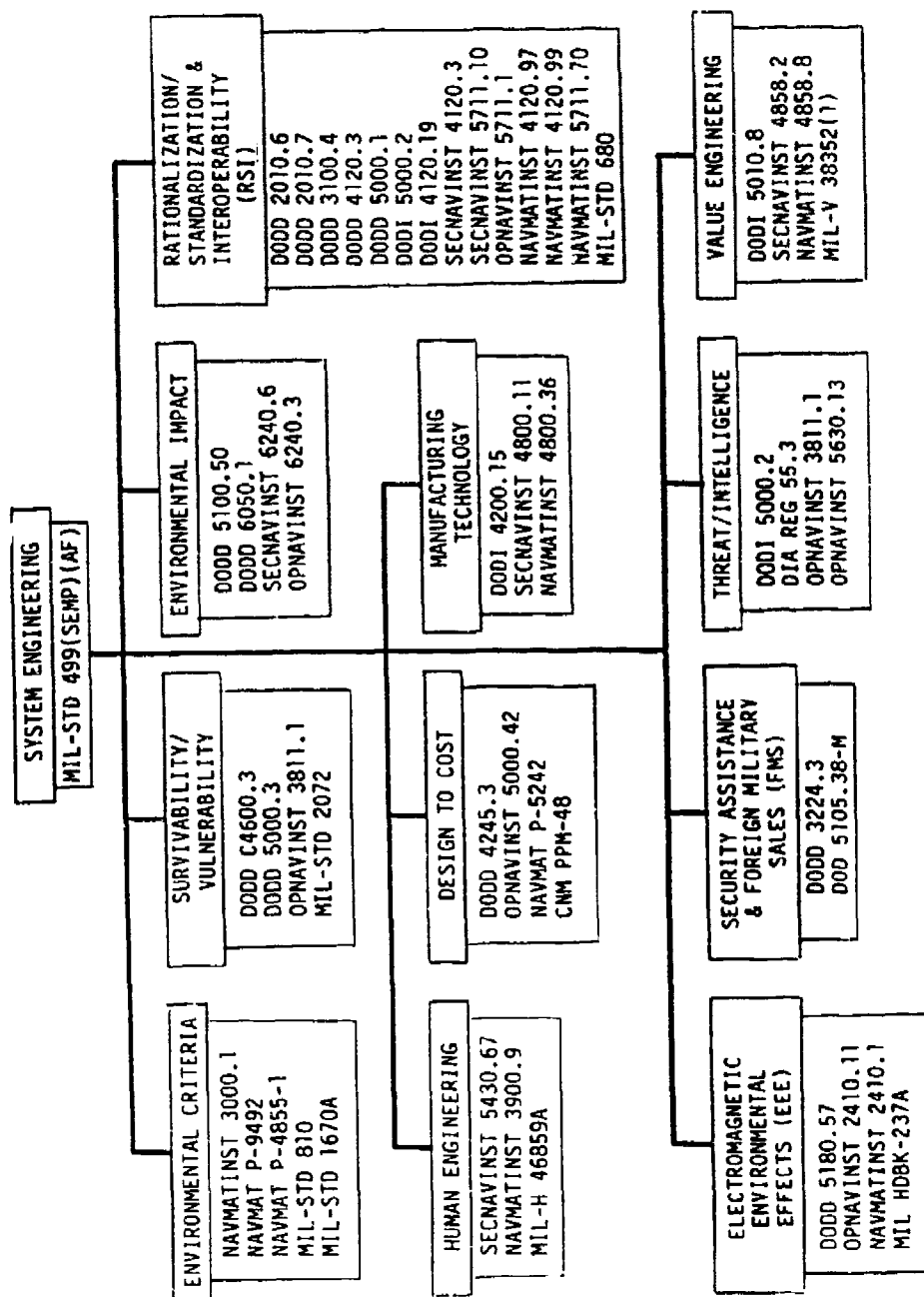


FIGURE 4-22, Sheet 9 of 9. Controlling Document List.

Appendix A

SYSTEMS ACQUISITION IN THE NAVY

Appendix A

THE DEPARTMENT OF THE NAVY ACQUISITION PROCESS

ACQUISITION POLICY - DEPARTMENT OF DEFENSE (DOD)

Acquisition policy as stated in DODD 5000.1 is as follows:

a. It is the policy of the Department of Defense to ensure that DOD acquisition of major defense systems is carried out efficiently and effectively to achieve operational objectives of the U.S. Armed Forces in their support of national policies and objectives, and that it meets the guidelines of reference (b) (OMB Circular A-109).

b. Management responsibility for system acquisition programs shall be decentralized except for the decisions specifically retained by the Secretary of Defense.

c. The management principles and objectives in this Directive (DODD 5000.1) shall be applied to the acquisition of defense system not designated as major.

ACQUISITION POLICY - DEPARTMENT OF THE NAVY (DON)

Basic policy for systems acquisition within the DON is promulgated by the Secretary of the Navy (SECNAV) in SECNAVINST 5000.1 which states that system acquisitions carried out to achieve the operational objectives of the Navy and Marine Corps are to be managed efficiently and effectively by:

- o Streamlining administrative procedures, such as eliminating redundant review and documentation requirements; and scheduling milestone reviews early enough to avoid gaps between phases;
- o Delegating management responsibilities to the lowest level possessing a total view of the program. Responsibilities and accountability are to be clearly established and commensurate resources provided;
- o Correlating the overall Planning, Programming and Budgeting System (PPBS) priority and status with individual program decisions; ensuring affordability of programs; and controlling cost growth within programs;
- o Tailoring, for each program, an acquisition strategy encompassing all internal and external elements of the acquisition process, including early integration of manpower, training and logistic support;
- o Pursuing readiness and sustainability based on realistic operational availability thresholds as primary objectives, equal in priority with achieving specified performance levels, from the start of a program;

- o Increasing program stability by developing improved long range plans; realistic budget and cost estimates; economical production rates; and, when appropriate, by multiyear contracting;
- o Applying established or evolving technology having a high probability of success. High technical risks may be taken if an extraordinary pay-off potential can be demonstrated;
- o Making well-balanced trade-offs between life-cycle costs, system effectiveness, and time between program initiation and approval for production;
- o Strengthening the industrial base and improving productivity; and
- o . Judiciously applying the following management considerations:

MANAGEMENT CONSIDERATIONS

1. ACQUISITION STRATEGY. From program start, an overall plan to acquire, produce and support the system shall be developed and tailored to the unique circumstances of the program. It shall set forth the objectives, resources, principal assumptions and contracting approach, including extent of competition. For ACAT I programs, the exceptions under OMB Circular A-109, Sections 11j, 12b, 12c or 13c (NOTAL) may be invoked, when appropriate. The acquisition strategy shall be executed with maximum tailoring, flexibility, innovation and common sense.

2. AFFORDABILITY. At each decision point, it shall be demonstrated that the program, as recommended, is affordable, by assessing program cost against program priority and available resources as established in the PPBS process. Programs not funded at a level adequate for full program execution shall be considered for termination. In between milestones, affordability is reassessed as part of the PPBS process; however, programmatic issues raised and decisions made at the last milestone shall not be readdressed. If any proposed PPBS action differs from the last milestone decision, the decision authority shall be notified promptly; and if it may cause a threshold breach for ACAT I or ACAT IIS programs, SECNAV approval is required.

3. ACQUISITION TIME. Programs shall be planned for system development within the shortest time reasonable. At each milestone, schedule alternatives and inherent risks shall be assessed. Methods to be considered include combination or omission of acquisition phases; smooth transition to production; single concept development; preplanned product improvement; use of alternatives in high risk areas; experimental prototyping or critical components; or coordination of common purchases between different programs.

4. COST ESTIMATING. Current life cycle cost estimates shall be prepared for each milestone. Successive cost estimates shall be traceable from Milestone 1, including reasons for inflation adjustments and cost growth.

5. OPERATIONAL CONCEPT. The operational concept shall initially be developed at Milestone I, finalized by Milestone II and maintained throughout the program and addressed in the milestone documentation.

6. PRODUCTION PLANNING. From the early phases, producibility of the design shall be a major consideration.

7. MANPOWER AND TRAINING. Systems shall be designed to minimize the number, skills and occupations required for operation and support. Trade-off studies shall be made among manpower (numbers and skill levels), support structure and equipment and system design. Manpower and training requirements shall be considered from program start and developed in detail by Milestone III.

8. LOGISTICS SUPPORTABILITY. Logistics supportability shall be a design requirement as important as cost, schedule and performance, and established as required by DODD 5000.39 of 17 January 1980 (enclosed in SECNAVINST 5000.39 (NOTAL)).

9. STANDARDIZATION. Intraservice/interservice standardization and interoperability requirements shall be considered. System design shall make optimum use of existing subsystems, components, parts and materials common to other available systems. However, essential performance requirements should not be compromised thereby, nor should application of new technology or innovative design be inhibited.

10. TEST AND EVALUATION. Test and evaluation are an integral part of the acquisition process to assess technical performance and risks, and operational effectiveness and suitability of a system. An efficient mix of analyses, simulations and laboratory tests prior to field tests will be applied in the order listed so that preceding evaluations adequately bound and eliminate unnecessary field testing. For ACAT I programs, references (a), (b) and (c) (DODD 5000.1, DODI 5000.2 and DODD 5000.3 respectively) apply. For ACAT IIS programs, the policies of reference (c) apply, and a Test and Evaluation Master Plan (TEMP) shall be developed for Milestone I and maintained throughout, including Follow-on Operational Test and Evaluation (FOT&E). Schedules shall be flexible to allow retest or reevaluation as necessary prior to a milestone, and shall avoid duplication commensurate with risk.

11. SOURCES. All capable entities, private or governmental, should be fully considered, small and disadvantaged business organizations, DON, Army or Air Force activities, federally-funded R&D Centers, not-for-profit organizations, colleges and universities. In particular, DON R&D Centers should be considered for development within their assigned function during all program phases with appropriate contractor support.

12. COMPETITION. As long as practicable, competition shall be sought in a creative manner, and maintained throughout the acquisition cycle. At each milestone, plans for enhancing competition shall be described, such as competitive teaming, direct licensing, leader company procurement, or component breakout. At Milestone II, it should be determined whether to acquire a design disclosure package of an end product drawings/specifications enabling competition.

13. CONTRACTING OUT. Functions of a policy/decision making or managerial nature which are the direct responsibility of DON officials shall not be performed by DON employees. While advice may be properly obtained by contract, contractor performance of basic management functions begins when contractor involvement is so extensive that it limits the DON ability to develop options other than proposed by the contractor.

14. ACQUISITION RISKS. Technical, operational, schedule, and cost risks shall be identified as early as possible and assessed continuously. They shall be disclosed in full to the decision authority and addressed realistically at each milestone. A management reserve based on the cost risk shall be established for ACAT I and IIS programs.

ACQUISITION PROCESS OUTLINE

While it is virtually impossible to describe all the steps in the acquisition process, the following pages describe, in the form of descriptive paragraphs and facing-page flow charts, the major steps in the DON's acquisition process for the various types of programs, i.e., Acquisition Categories (ACATs). The description identifies the various officials and special groups involved, the documentation used and the review and approval process.

When appropriate, a "NOTE" is added to the end of a paragraph to highlight options for the action called for in the paragraph or to provide some insight into the action described.

In the case where an acquisition documents or a review groups is mentioned in the description that follows and are also described in the body of the GUIDE, an appropriate page reference is provided.

ACQUISITION PROCESS OUTLINE

PROGRAM INITIATION

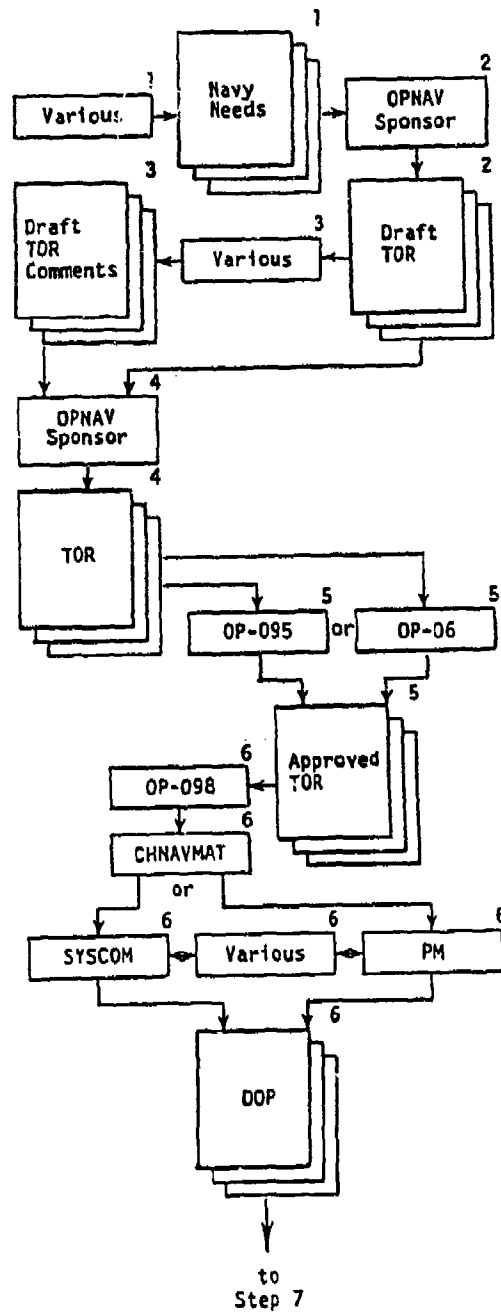
1. Inputs for Navy needs may be submitted to Office of the Chief of Naval Operations (OPNAV) sponsors by Deputy Chiefs of Naval Operations/Directors of Major Staff Offices (DCNOs/ DMSOs), Fleet Commanders in Chief (CINCs) or others.
2. When the need for a new system is perceived and is believed to be affordable, a draft Tentative Operational Requirement (TOR) (see page 2-1) is originated by the OPNAV sponsor.
3. The draft TOR is forwarded for comment to Fleet CINCs, selected offices within OPNAV, Commander, Operational Test and Evaluation Force (COMOPTEVFOR) and others as appropriate.
4. Based on the comments received, the OPNAV sponsor revises the draft TOR as necessary.
5. The TOR is submitted to the Office of Naval Warfare (OP-095) for review and approval. TORs for strategic nuclear systems are submitted to the DCNO (Plans, Policy and Operations) (OP-06) for approval.

NOTE: TORs may be issued at any time in the annual cycle. A rule of thumb, for planning purposes, is that the TOR should be issued about a year in advance of the Program Objectives Memorandum (POM) submission which will contain the initial funding.

6. Once approved by OP-095, the TOR is promulgated by the Office of the Director, Research, Development, Test and Evaluation (OP-098) and forwarded to the Chief of Naval Material (CHNAVMAT). CHNAVMAT in turn assigns it to the appropriate Systems Command (SYSCOM) commander or CHNAVMAT designated program manager (PM). The SYSCOM commander or PM, on receipt of the TOR, explores the options adequately, interfacing with Navy laboratories, industry and COMOPTEVFOR as appropriate, to produce a Development Options Paper (DOP) (see page 2-1) which describes a range of possible systems covering a spectrum of capabilities.

ACQUISITION PROCESS OUTLINE

PROGRAM INITIATION



ACQUISITION PROCESS OUTLINE

PROGRAM INITIATION

7. The DOP is transmitted to the OPNAV sponsor via CHNAVMAT with copies to selected OPNAV offices, COMOPTEVFOR and others as appropriate. The OPNAV sponsor selects the alternative which best matches the desired capabilities with affordability considerations. Based on this selection the OPNAV sponsor originates an Operational Requirement (OR) (see page 2-1) defining the major characteristics of the selected system. For potential DOD major programs (ACAT I), a Justification for a Major System New Start (JMSNS) (see page 2-2) is prepared in lieu of an OR.
8. The OR/JMSNS is routed, via DCNO (Manpower, Personnel and Training) (OP-01), DCNO (Logistics) (OP-04) and the Plans and Programs Office (OP-090), to OP-095 for review and approval. High-cost or controversial programs must be concurred in by Chief of Naval Operations/ Vice Chief of Naval Operations (CNO/VCNO) prior to approval of the OR/JMSNS. OP-090 decides whether this approval is accomplished by the CNO Executive Board/Acquisition Review Committee/Ship Characteristics Improvement Board (CEB/ARC/SCIB) (see page 2-35) or directly by OP-095. For strategic nuclear systems, the OR/JMSNS is reviewed and approved by CP-06.
9. Once approved, the OR/JMSNS is promulgated by OP-098 to CHNAVMAT with copies to all appropriate commands and offices. CHNAVMAT assigns the OR/JMSNS to the appropriate SYSCOM commander or CHNAVMAT designated PM who will initiate planning for the program described in the OR/JMSNS.

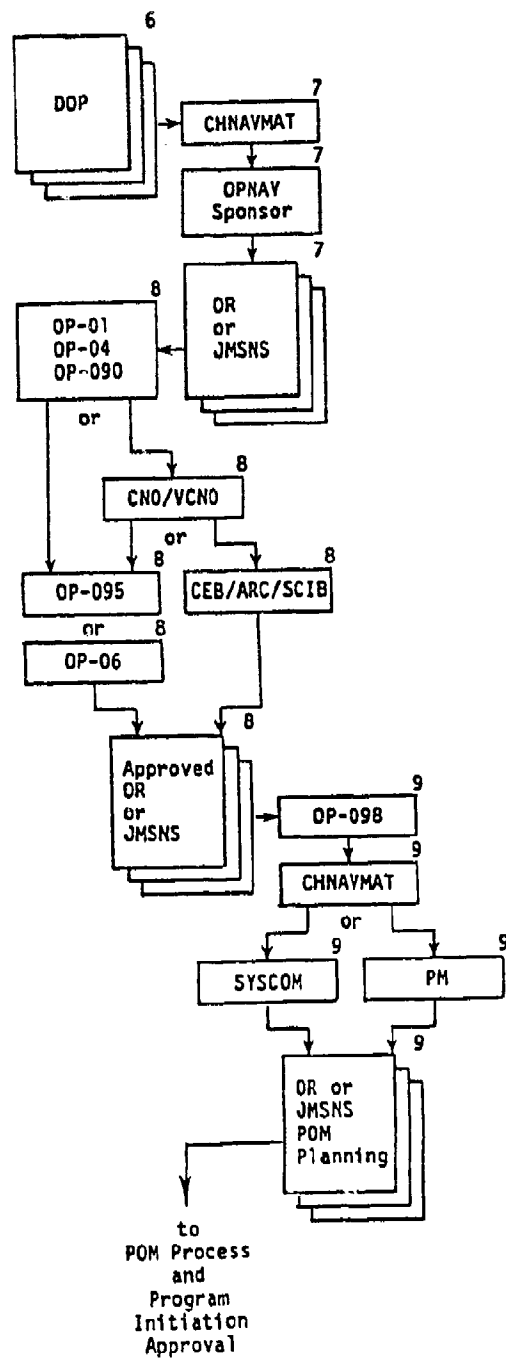
NOTE: ORs/JMSNSs may be issued at any time. However, if a new start is to be included in the POM submission in May, the OR/JMSNS must be promulgated by the preceding 1 February. This will allow about two months for OPNAV and Secretary of the Navy (SECNAV) review of the requirement and the proposed program prior to the final POM decision on funding.

NOTE: When a Navy POM with a JMSNS for a new major program is submitted to the SECDEF for approval, the SECDEF denotes his approval in the Program Decision Memorandum (PDM). When a program represented by a JMSNS is modified by the SECDEF, the changes are documented in a SECDEF Decision Memorandum (SDDM) (see page 2-33).

NOTE: If, subsequent to approval of an OR/JMSNS, the resulting program is not funded in the first or second year of the next POM, the OR/JMSNS is canceled by OP-098.

ACQUISITION PROCESS OUTLINE

PROGRAM INITIATION



ACQUISITION PROCESS OUTLINE

MILESTONES I, II & III

10. Once a program has made sufficient progress to allow it to enter into the next phase of acquisition and the development and operational test reports are available, the PM prepares or revises the necessary milestone decision review documents. For ACAT I programs these are a System Concept Paper (SCP) (see page 2-32) and Test and Evaluation Master Plan (TEMP) (see page 2-32), for Milestone I, or a Decision Coordinating Paper (DCP) (see page 2-50) and TEMP for Milestones II and III. For an ACAT IIS and ACAT IIC, the decision documents are a Navy Decision Coordinating Paper (NDCP) (see page 2-32) and TEMP for all milestones. For ACAT III and ACAT IV programs, the decision document, for all milestones, is the TEMP. In addition all program require the preparation of an Approval for Production action sheet for the Milestone III review.. Based on these documents the PM prepares his Milestone Review Presentation. The SCP/DCP/NDCP/TEMP are forwarded by the PM, through the chain-of-command, to the appropriate decision authority level for staff review/recommendations prior to the milestone decision review.

NOTE: For ACAT I programs, at Milestones II and III, SECDEF may require some elements of the Integrated Program Summary (IPS) (see page 2-50) as backup for the information contained in the DCP.

NOTE: ACAT III and ACAT IV programs do not normally have a Milestone I. However, a TEMP is required at the approximate time of Milestone I (near the beginning of the first fiscal year containing program funding).

11. The PM gives his Milestone Review Presentation to the SYSCOM Acquisition Review Board (ARB) (see page 2-36). If the ARB is in agreement that the program is ready to enter the next phase, it so recommends to the CHNAVMAT. For ACAT IV programs, Systems Command Commander (SYSCOM CDR) approval of such an ARB recommendation and the documentation of that decision in a SYSCOM CDR decision memorandum provides the PM with the necessary go-ahead to proceed with the next acquisition phase.

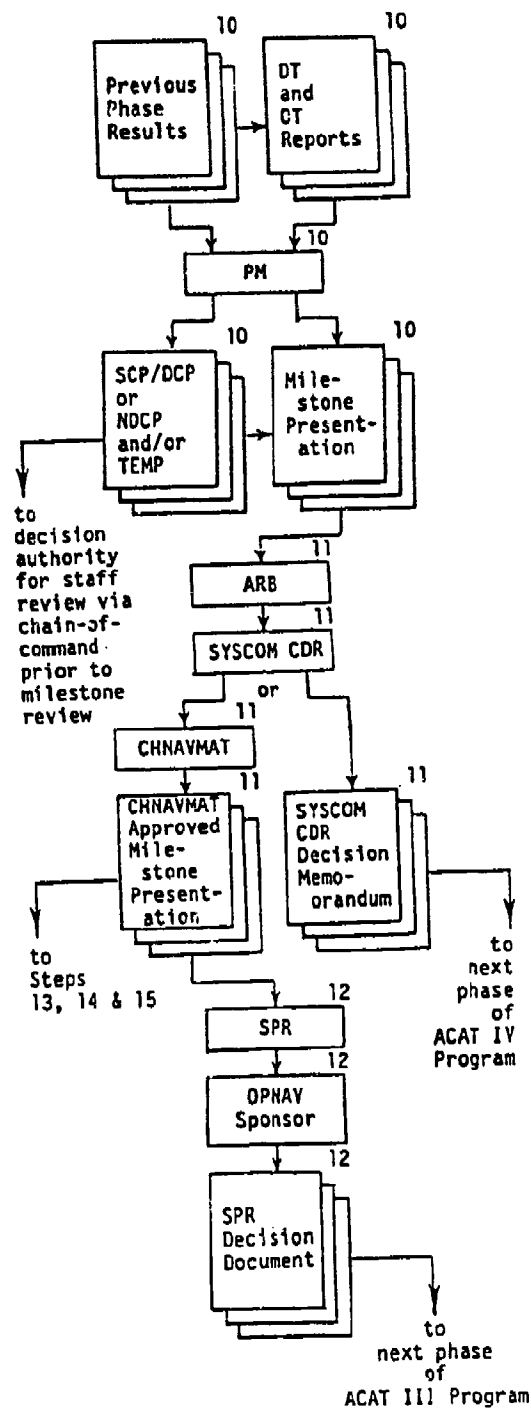
NOTE: For ACAT IVT programs, if COMOPTEVFOR and the SYSCOM disagree, CHNAVMAT is the decision maker.

12. For ACAT III programs, after CHNAVMAT approval, the PM's Milestone Review Presentation is forwarded to the OPNAV sponsor who convenes a Sponsor's Program Review (SPR) (see page 2-35). At the conclusion of the SPR, the OPNAV sponsor drafts the SPR decision document (see page 2-33). After review of the draft by OP-090, OP-098 and OP-04, the SPR decision document is approved and promulgated by the OPNAV sponsor. The approved SPR decision document provides the necessary authority for the PM to proceed with the next phase.

NOTE: If there are significant disagreements as to what the recommendation should be, they are resolved by OP-090.

ACQUISITION PROCESS OUTLINE

MILESTONES I, II & III



ACQUISITION PROCESS OUTLINE

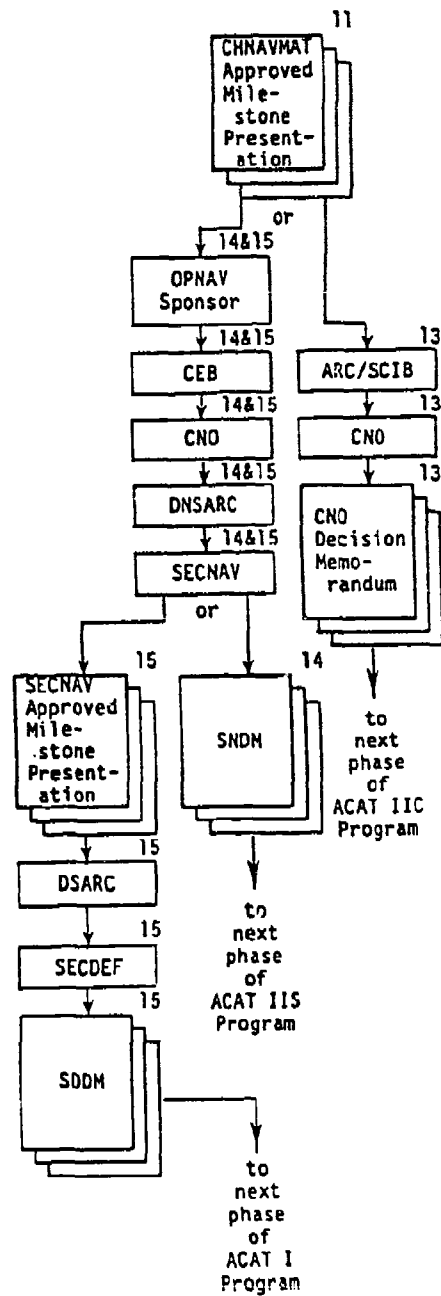
MILESTONES I, II & III

13. For ACAT IIC programs, after CHNAVMAT approval, the PM's Milestone Review Presentation is forwarded to the OPNAV Sponsor who submits it to the ARC or SCIB for review and recommendations. The ARC or SCIB recommendations are submitted to the CNO for review and approval. A favorable recommendation to and approval by the CNO documented in a CNO decision memorandum provides, for ACAT IIC programs, the PM with the authority to enter the next phase of the acquisition process.
14. For ACAT IIS programs, after CHNAVMAT approval of the PM's Milestone Review Presentation, the Presentation is given to the CEB and, with CNO approval, is given to the Department of the Navy Systems Acquisition Review Council (DNSARC) (see page 2-34). The DNSARC recommendations are submitted to the SECNAV for review and approval. A favorable recommendation to and approval by the SECNAV, documented in a SECNAV decision memorandum (SNDM) (see page 2-33) provides, for ACAT IIS programs, the PM with the authority to enter the next phase of the acquisition process.
15. For ACAT I programs, the CHNAVMAT, CNO and SECNAV approved PM's Milestone Review Presentation, is submitted to the Defense Systems Acquisition Review Council (DSARC) (see page 2-34) for review. The DSARC recommendations are submitted to the SECDEF for review and approval. A favorable DSARC recommendation and Secretary of Defense (SECDEF) approval, documented in an SDDM, provides the PM, for ACAT I programs, the authority to enter the next phase of the acquisition process.

NOTE: Normally the Milestone III decision for an ACAT I program is delegated, by the SECDEF, to the SECNAV unless the thresholds established at Milestone II are breached.

ACQUISITION PROCESS OUTLINE

MILESTONES I, II & III



Appendix B

PLANNING, PROGRAMMING & BUDGETING SYSTEM (PPBS)

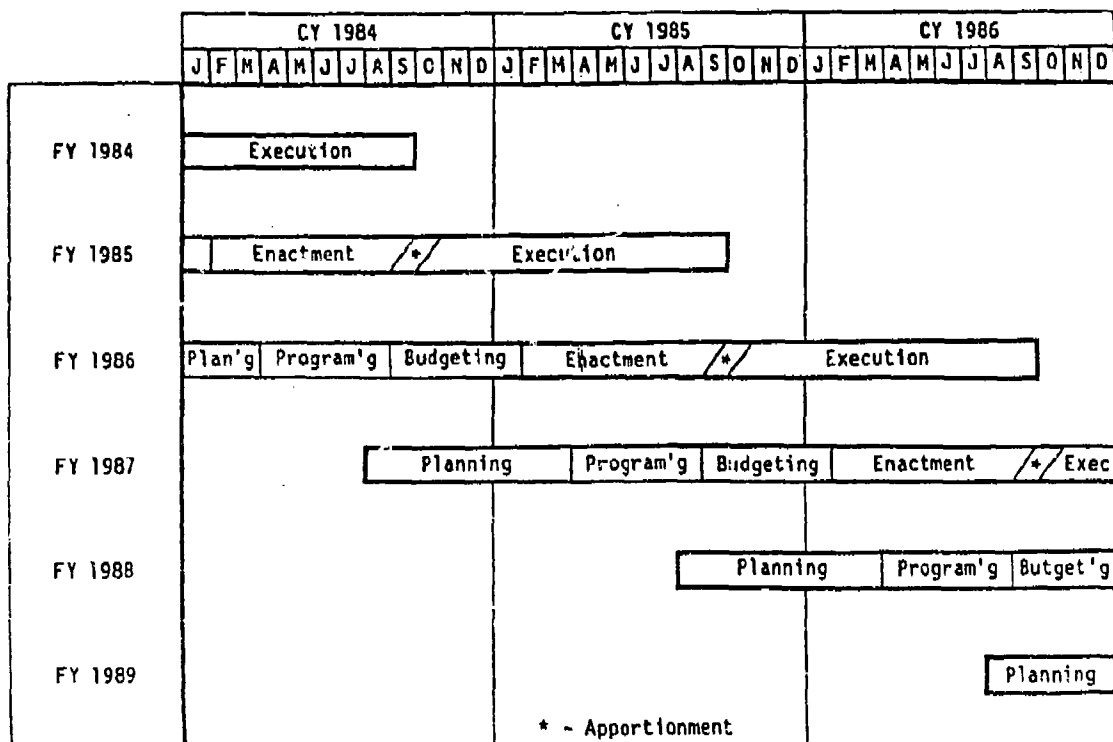
Appendix B

PLANNING, PROGRAMMING, BUDGETING SYSTEM (PPBS)*

The PPBS can be summarized in a few words. Based on the anticipated THREAT, a STRATEGY is developed. In support of that strategy, force REQUIREMENTS are developed. Based on those requirements, PROGRAMS are developed to provide, on an orderly basis, weapons systems and manpower over a period of time, with due consideration of the total cost to the nation. Lastly, funds must be BUDGETED in such a manner as to obtain the required forces and weapon systems within the resources that the nation provides.

The PPBS process, so briefly outlined above, is presented on the following pages in the form of descriptive paragraphs and facing page flow charts. The PPBS cycle shown is for the Fiscal Year 1986 budget which started in August of 1983 and ends in September 1985. Where appropriate, a NOTE has been added to the end of certain descriptive paragraphs to indicate that there are options to the action called for in that paragraph or to provide some other insight into the action described.

The charts necessarily show the process as a progression of the major steps as it proceeds from initial high-level strategic decisions and guidance to the final submission by the Secretary of Defense (SEC-DEF) of the Department of Defense (DOD) budget. This should not be interpreted to mean that the PPBS is linear in operation. As shown below, the budgets for three fiscal years are always simultaneously in work at different stages of the cycle. Iterative information flows continuously in both directions, both within and between cycles.



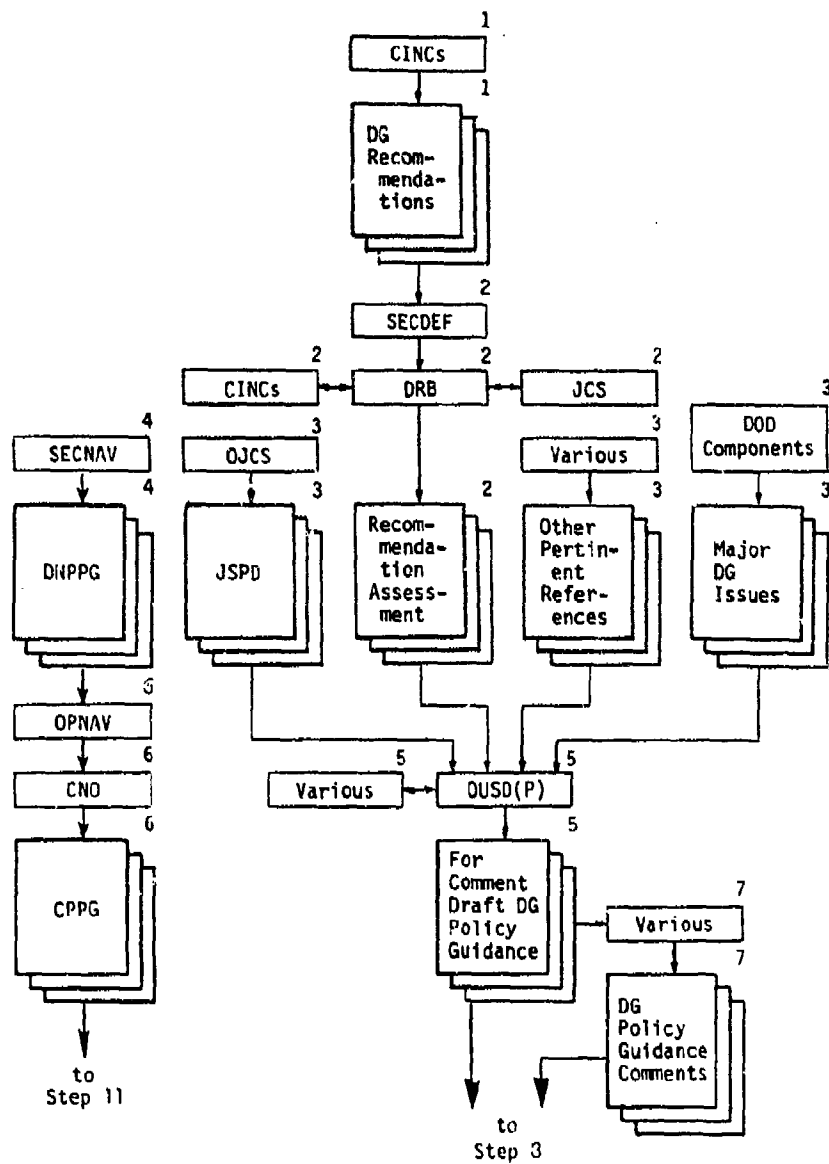
PLANNING PHASE (August 1983 to early October 1983)

1. In August, the Commanders of the Unified and Specified Commands (CINCs) prepare their personal recommendations for major changes in the previous Defense Guidance (DG).
2. In late August, the CINCs' recommendations are furnished to the Secretary of Defense (SECDEF). After submittal, the Joint Chiefs of Staff (JCS) and the CINCs meet with the Defense Resources Board (DRB) to review and assess their recommendations.
3. In late August/early September, various organizations provide major DG issues to the planning process to the SECDEF. These include: the Joint Strategic Planning Document (JSPD) from the Organization of the JCS (OJCS); major issues which the Department of Defense (DOD) Components wish to have considered during the development of the DG; and other references pertinent to the development of Policy, Strategy and Force Planning sections of the DG.
4. At this time, the Secretary of the Navy (SECNAV) issues the Department of the Navy Policy and Planning Guidance (DNPPG) which provides top level broad guidance for Navy planning.

NOTE: Part of the DNPPG is used by the Navy to provide input for the major DG issues in Step 3 above.

5. In September, based on the DRB assessment of the CINCs' recommendations and the other key inputs, the Office of the Under Secretary of Defense, Policy (OUSDP) develops, in coordination with the staffs of the DOD Components, the OJCS and the Office of the SECDEF (OSD), a "For Comment" draft of the Policy Guidance section of the Threat Assessment, Policy, Strategy and Force Planning part of the DG.
6. In September, based on the DNPPG guidance, the Office of the Chief of Naval Operations (OPNAV) prepares the Chief of Naval Operations Policy and Planning Guidance (CPPG) setting forth the strategy to be used in formulating Navy programs. The CPPG is issued after review and approval by the Chief of Naval Operations (CNO).
7. In early October, the OUSDP provides the For Comment draft Policy Guidance section of the DG to the DOD Components, the CINCs, the staff of the National Security Council (NSC), the Department of State and the Office of Management and Budget (OMB) for review and comment.

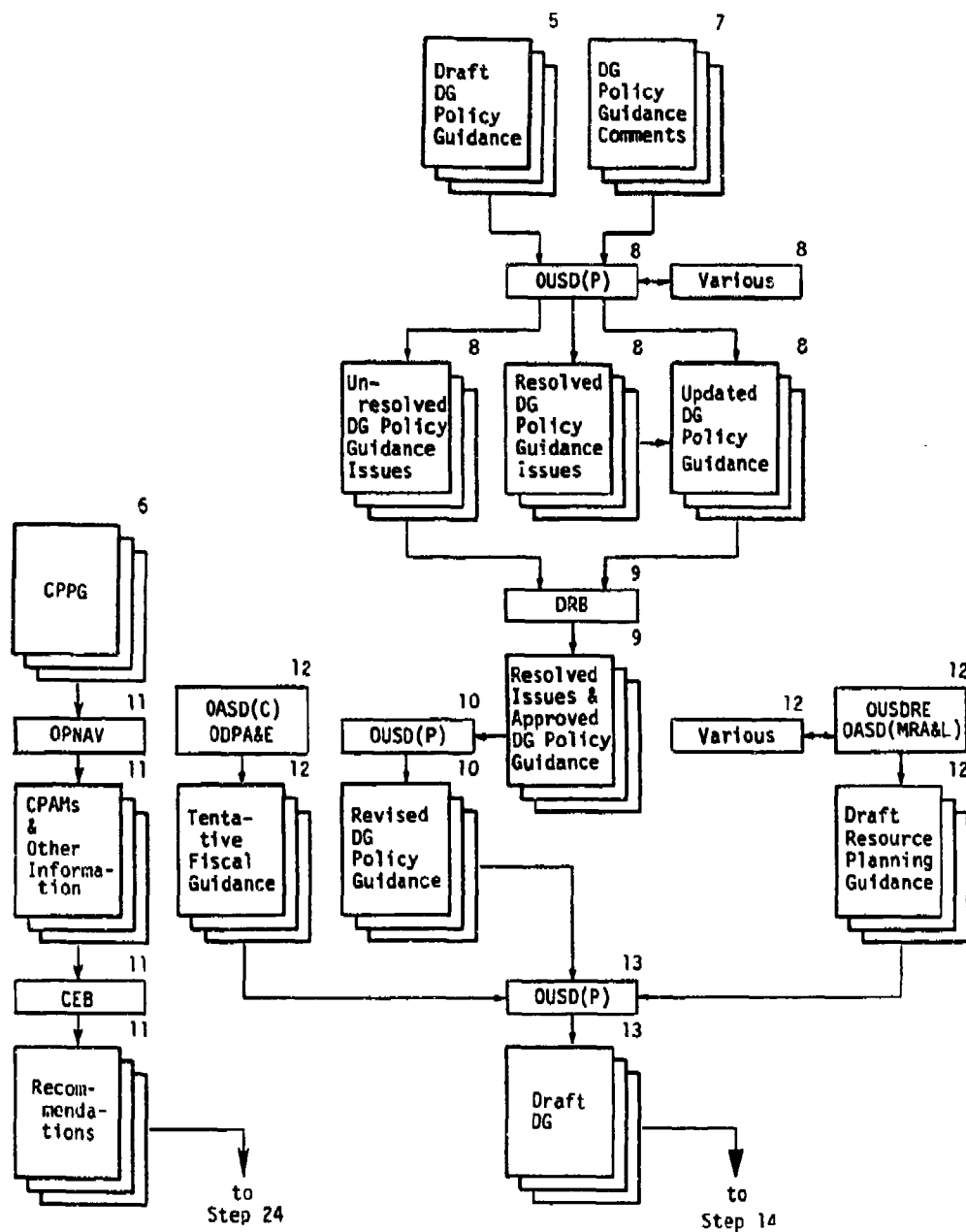
PLANNING PHASE



PLANNING PHASE continued (mid-October 1983 to early November 1983)

8. Before mid-October, the various comments are submitted to the OUSD(P). Where possible, issues raised by the comments are resolved between the various staffs and incorporated in an updated Policy Guidance section of the DG. Other issues are identified as requiring DRB review and resolution.
9. In late October, the DRB meets to resolve the remaining issues and to review and approve and/or modify the updated Policy Guidance section of the DG.
10. In late October, the OUSD(P) revises, as necessary, the updated Policy Guidance section of the DG.
11. From October to January, based on the CPPG, OPNAV prepares and submits Chief of Naval Operations Program Analysis Memoranda (CPAMs), Naval Warfare Appraisals and other information to the Chief of Naval Operations Executive Board (CEB) which formulates recommendations for the CNO.
12. In September/October 1983, the Under Secretary of Defense, Research and Engineering (USDR&E) and the Office of the Assistant Secretary of Defense, Manpower, Reserve Forces and Logistics (ASD-(MRA&L)), in coordination with the Office of the Assistant Secretary of Defense, Comptroller (OASD(C)), the Office of the Director, Program Analysis and Evaluation (ODPA&E) and the staffs of the DOD Components, the OJCS and the OSD, prepare a draft Resources Planning Guidance. At the same time, the OASD(C) and the ODPA&E prepare a Tentative Fiscal Guidance.
13. In early November, the draft Resource Planning Guidance and the Tentative Fiscal Guidance are forwarded to the OUSD(P). Based on these documents and the revised Policy Guidance section of the DG, the OUSD(P) prepares the draft DG.

PLANNING PHASE

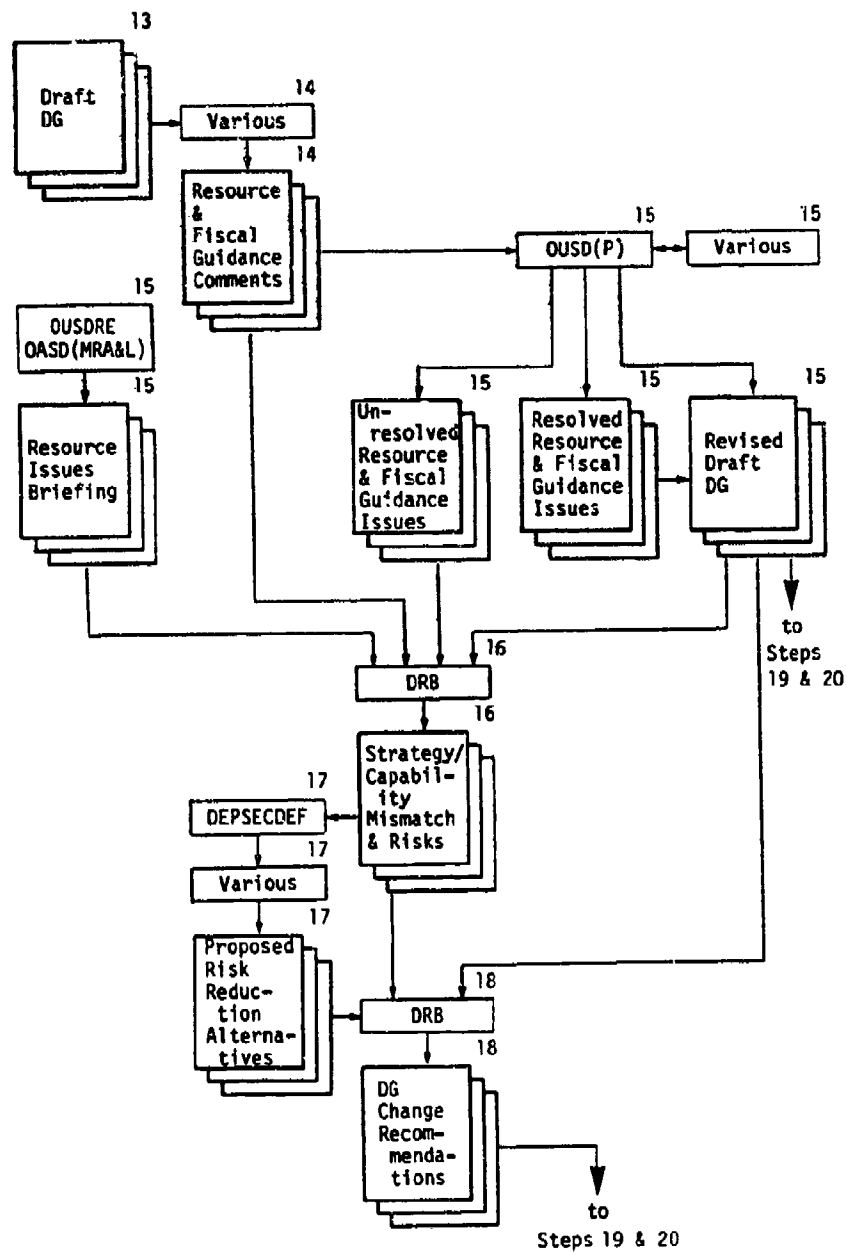


PLANNING PHASE continued (early November 1983 to early December 1983)

14. In early November, the Draft DG is provided to the DOD Components, the CINCs, the NSC staff, the Department of State and the OMB for review and comment on the Resources and Tentative Fiscal Guidance sections of the draft DG.
15. By mid-November, the various comments are provided to the OUSD-(P). Again, where possible, issues raised by the comments are resolved between the various staffs and the draft DG revised as necessary. Issues requiring DRB review and resolution are identified. At the same time, the OUSDRE and the OASD(MRA&L) prepare briefings on the resources issues of the draft DG.
16. In late November, the DRB meets to review the revised draft DG and, the various comments on the draft DG and to resolve the remaining issues on the draft DG. The DRB is also briefed on the resource implications and constraints of the revised draft DG. This review and briefing provide an early insight into areas of strategic capability mismatches and risks.
17. In late November/early December, as a result of the DRB review and briefing, the SECNAV and other Service Secretaries, OSD members and the JCS, working with the DRB members, are tasked, as necessary, by the Deputy SECDEF (DEPSECDEF), to develop proposed alternative solutions to reduce the identified risks.
18. In early December, these proposed solutions are presented to the DRB. As a result of this review, the DRB develops its recommendations for changes to the revised draft DG.

NOTE: In some cases, the DRB may recommend that the SECDEF request an increase in resources to reduce the mismatch and risks.

PLANNING PHASE



PLANNING PHASE continued (mid-December 1983 to early January 1984)

19. By mid-December, the OJCS, based on the revised draft DG and the DRB recommendations, prepares tables of expected major forces which it estimates will minimize the risks involved and an assessment of the risks associated with their ability to carry out the strategy contained in the DRB recommendations.
20. In mid-December, the DRB decisions on major issues, that result in changes in guidance emphasis/force mixes, are reflected, by the OUSD(P), in an updated draft DG. At this time, the OUSD(P) also prepares a list of any unresolved problems and/or issues.
21. At the end of December, the updated draft DG, the DRB recommendations as to mismatch and risks, the associated OJCS force tables and risk assessment and any unresolved problems and/or issues are reviewed and resolved by the SECDEF.
22. In early January, based on the updated draft DG and the SECDEF decisions, the OUSD(P) prepares the proposed DG.
23. In early January, the proposed DG is presented to the SECDEF for review and approval.

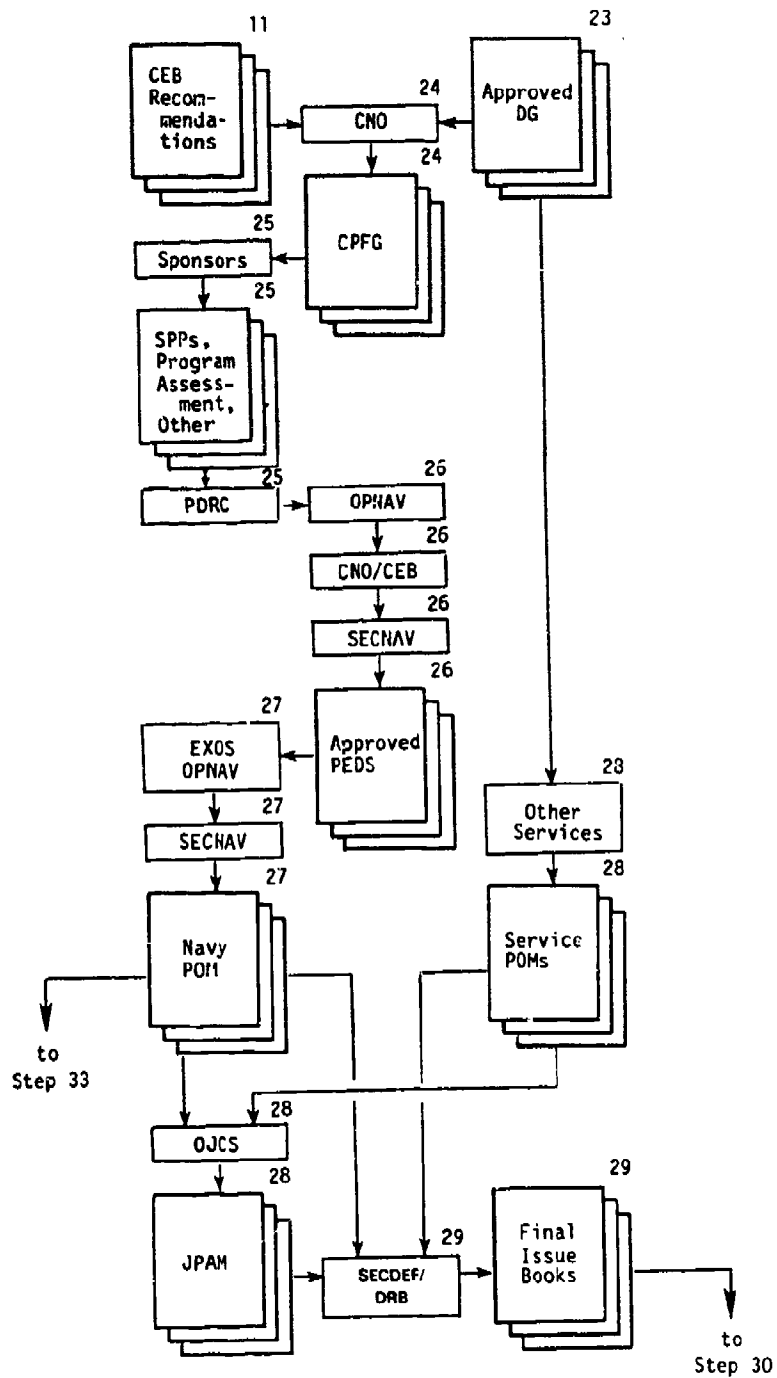
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PROGRAMMING PHASE (January 1984 to June 1984)

24. In early February, based on the DG, the CEB recommendations and the CNO's direction, OPNAV promulgates the CNO Programming and Fiscal Guidance (CPFG) which provides guidance for the development of the Navy Program Objectives Memorandum (POM).
25. In March, OPNAV Sponsors prepare, based on the CPFG, and present Sponsor Program Proposals (SPPs) and program assessments to the Program Development Review Committee (PDRC) for review and approval.
26. In April, based on the SPPs and PDRC recommendations, OPNAV prepares the Program Evaluation and Decision Summary (PEDS) which is presented first to the CNO and CEB and then to SECNAV for review and approval.
27. In May, OPNAV and the SECNAV Staff prepare the Navy POM and submit it to the SECNAV for review and approval.
28. In May, copies of the Navy POM and the POMs of the other DOD Components are provided to the SECDEF, the DRB members and the OJCS. Based on its review of the POMs, the OJCS prepares its Joint Program Assessment Memorandum (JPAM).
29. In June, the JPAM is forwarded to the DRB members. The DRB members' staffs, after review of the POMs and the JPAM, identify any issues raised by this review. As many issues as possible are resolved between the DRB members' staffs and the DOD Components and the OJCS. Issues which cannot be resolved are documented as Issue Papers for insertion into the Final Issues Book.

PROGRAMMING PHASE



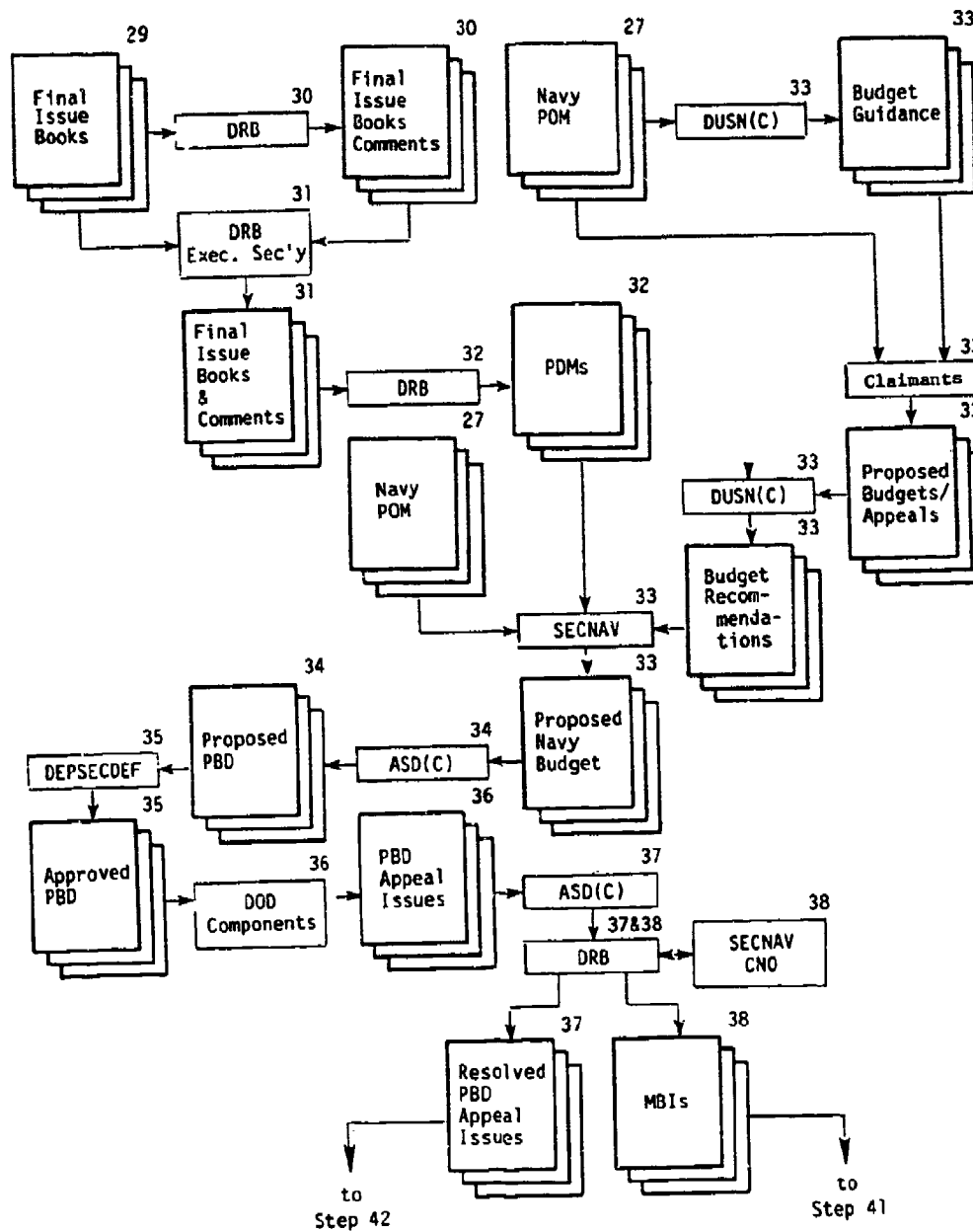
PROGRAMMING PHASE continued (June 1984 to July 1984)

30. In June, copies of the Final Issues Books are provided to the DRB members for review and brief executive-level comments.
31. In July, the DRB comments are provided to the DRB Executive Secretary for Assembly into Issue Books.
32. In July, the Issue Books and comments are provided to the DRB for review. After review, the DRB determines its position on the POMs. These positions are recorded in a set of Program Decision Memoranda (PDMs), one PDM for each POM.

BUDGETING PHASE (June 1982 to early December 1982)

33. In June and July, based on the Navy POM and guidance from the Deputy Under SECNAV (Comptroller) (DUSN(C)), the Navy Claimants prepare and submit their proposed budgets to the DUSN(C). Based on these submittals and any late appeal, the DUSN(C) prepares his recommendations. The POM, PDM, proposed Claimant budgets and the DUSN(C) recommendations and resultant SECNAV decisions form the basis for the Navy's budget.
34. In September, the proposed budgets of the DON and the other DOD Components are submitted to the Assistant Secretary of Defense (Comptroller) (ASD(C)). After review, the ASD(C) determines his positions on the proposed budgets. These positions are recorded in a set of proposed Program Budget Decisions (PBDs), one for each submitted budget.
35. In October and November, the proposed PBDs are submitted to the DEPSECDEF for review and approval.
36. In October and November, copies of the PBDs are also supplied to the DON and other DOD Components. After review, the DON and other DOD Components prepare, for items they are in disagreement with, appeal issues.
37. In November, the DON's and other DOD Components' appeal issues are presented to the DRB for review and resolution.
38. In mid-December, the SECNAV and CNO, and the other DOD Components Secretaries and Service Chiefs meet with the DRB to resolve major budget issues (MBIs) still outstanding and of sufficient importance to be brought directly to the attention of the SECDEF.

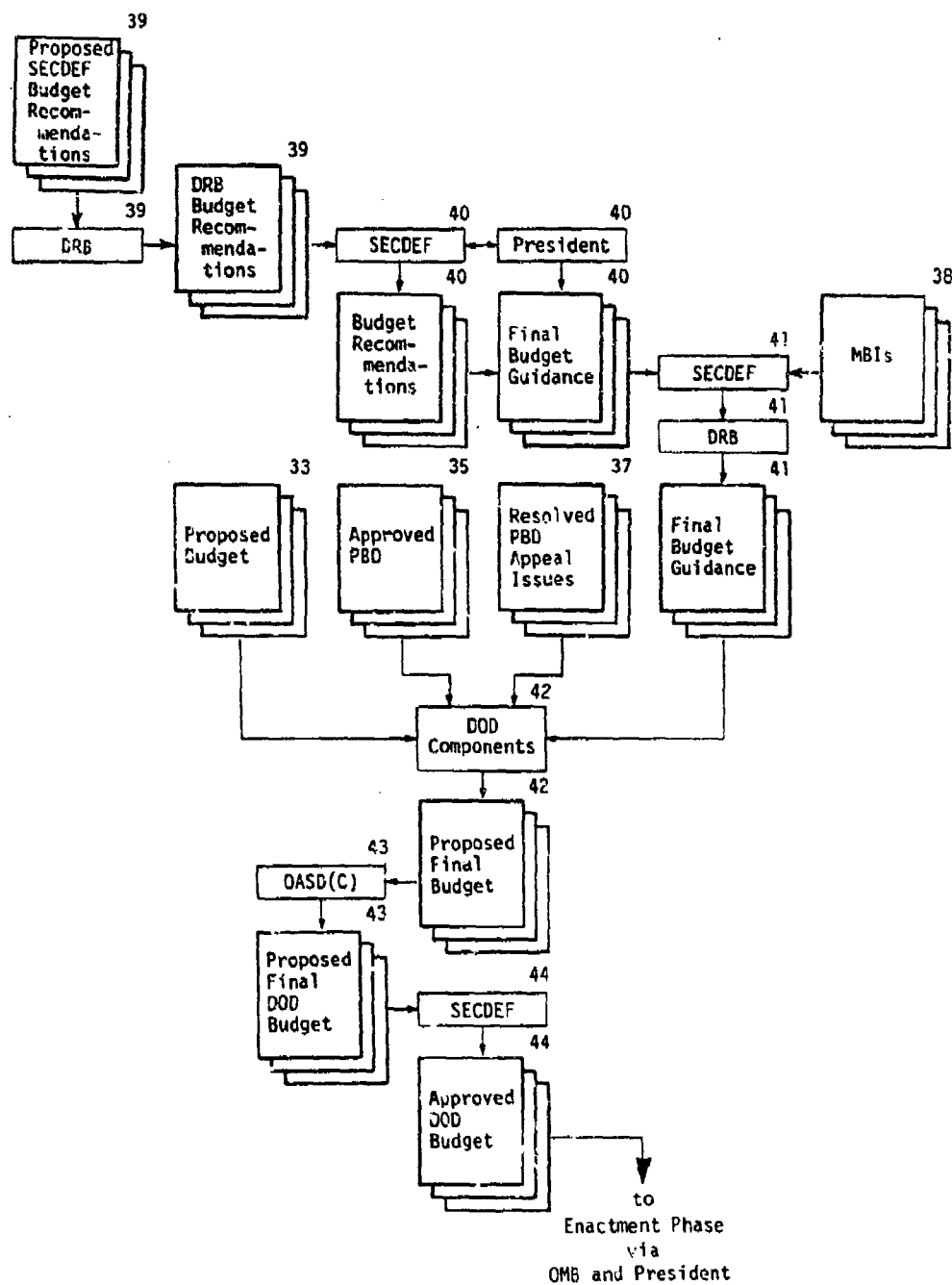
PROGRAMMING/BUDGETING PHASE



BUDGETING PHASE continued (early December 1984 to January 1985)

39. In early December, the DRB meets to review the SECDEF's proposed budget recommendations which he plans to present to the President. Based on that review, the DRB prepares its recommendations to the SECDEF.
40. In mid-December, the DRB's recommendations are submitted to the SECDEF. The SECDEF, in turn, makes his recommendations to the President who, after review, provides the SECDEF with his final budget guidance.
41. In mid-December, based on the approved PBDs, the DOD Components' PBD appeals and MBIs resolutions and the President's final budget guidance provided to the SECDEF, the DRB meets to establish the final budget guidance for the DON and other DOD Components, which is transmitted by the final PBDs.
42. In late December, the DON and other DOD Components prepare their proposed Final Budgets based on the final budget guidance, their earlier submitted proposed budgets, the approved PBDs and their PBD appeal issue resolutions.
43. In late December, the DON and other DOD Components' proposed Final Budgets are forwarded to the Office of the ASD(C) (OASD(C)) which combines them into a single proposed DOD Budget.
44. In late December/early January, the proposed Final DOD Budget is submitted to the SECDEF for review and approval. The DOD Budget is then forwarded to Office of Management and Budget (OMB) where it is incorporated into a single National Budget, approved by the President and submitted to the Congress, in January, enactment.

BUDGETING PHASE



Appendix C

ABBREVIATIONS

Appendix C

ABBREVIATIONS

A

| | |
|------------|---|
| AAW | Anti-Air Warfare |
| ACAT | Acquisition Category |
| ACO | Administrative Contracting Officer |
| ACWP | Actual Cost of Work Performed |
| ADM | Advanced Development Model |
| ADPO | Advanced Development Project Office |
| AFP | Approved (approval) for Full Production |
| AFPRO | Air Force Plant Representative Office |
| AFWTF | Atlantic Fleet Weapons Training Facility |
| ALP | Approved (approval) for Limited Production |
| ALT | Administrative Lead Time |
| AP | Acquisition Plan |
| APDM | Approved Program Decision Memorandum |
| APM | Assistant Program Manager |
| AR | (Nav)Air Regulation |
| ARB | Acquisition Review Board |
| ARC | Acquisition Review Committee |
| AS | Aerospace Standard |
| AS | NAV(AIR) Specification |
| ASD | Assistant Secretary of Defense |
| ASD(C) | Assistant Secretary of Defense (Comptroller) |
| ASD(C3I) | Assistant Secretary of Defense (Command, Control, Communication and Intelligence) |
| ASD(ISA) | Assistant Secretary of Defense (International Security Affairs) |
| ASD(MRA&L) | Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) |
| ASN | Assistant Secretary of the Navy |
| ASN(FM) | Assistant Secretary of the Navy (Financial Management) |
| ASN(M&RA) | Assistant Secretary of the Navy (Manpower and Reserve Affairs) |
| ASN(RE&S) | Assistant Secretary of the Navy (Research, Engineering and Systems) |
| ASN(S&L) | Assistant Secretary of the Navy (Shipbuilding and Logistics) |
| ASP | Acquisition Strategy Plan |
| ASPJ | Advanced Self-Protection Jammer |
| ASU | Approval for Service Use (replaced with AFP) |
| ASUW | Anti-Surface Warfare |
| ASW | AntiSubmarine Warfare |
| AUTEC | Atlantic Underseas Test and Evaluation Center |
| ATM | Assistant Technical Manager |

B

| | |
|------|---------------------------------|
| BCE | Baseline Cost Estimate |
| BCWP | Budgeted Cost of Work Performed |

-B-
(continued)

| | |
|------|---------------------------------|
| BCWS | Budgeted Cost of Work Scheduled |
| B.S | Board of Inspection and Survey |
| BM | Business Manager |
| BUL | Bulletin |

C

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|-------------|--|
| CA | Commercial Activities |
| CAIG | Cost Analysis Improvement Group |
| CBD | Commerce Business Daily |
| CBR | Chemical, Biological, Radiological |
| CCB | Change Control Board |
| CDR | Critical Design Review |
| CDRL | Contract Data Requirements List |
| CE | Concept Exploration (Phase) |
| CEB | CNO Executive Board |
| CICA | Competition in Contracting Act of 1984 |
| CINC | Commander-in-Chief |
| CJCS | Chairman, Joint Chiefs of Staff |
| CMC | Commander, Marine Corps |
| CNET | Chief, Naval Education and Training |
| CNM | Chief of Naval Material |
| CNO | Chief of Naval Operations |
| CO | Contracting Officer |
| COMOPTEVFOR | Commander, Operational Test and Evaluation Force |
| CPAF | Cost Plus Award Fee |
| CPAM | CNO Program Analysis Memorandum |
| CPFF | Cost Plus Fixed Fee |
| CPFG | CNO Program and Fiscal Guidance |
| CPIF | Cost Plus Incentive Fee |
| CPM | Critical Path Method |
| CPPG | CNO Planning and Programming Guidance |
| CRDL | Contract Data Requirements List |
| CS | Cost Sharing |
| C/SCS | Cost/Schedule Control System |
| CSS | Cost Support Services |
| CTR | Center |

D

| | |
|-------|---|
| DA | Development Activity |
| DADM | Decision Authority Decision Memorandum |
| DAES | Defense Acquisition Executive Summary |
| D&F | Determination and Findings |
| D&V | Demonstration and Validation |
| DC | Development Coordinator |
| DCAS | Defense Contract Administration Service |
| DCASR | Defense Contract Administration Service Representative/ Region |
| DCNM | Deputy Chief of Naval Material |

-D-
(continued)

| | |
|-------------|---|
| DCNM(A) | Deputy CNM (Acquisition) |
| DCNM(C&BM) | Deputy CNM (Contracts and Business Management) |
| DCNM(L) | Deputy CNM (Logistics) |
| DCNM(R&M) | Deputy CNM (Reliability and Maintainability) |
| DCNM(RM&QA) | Deputy CNM (Reliability, Maintainability and Quality Assurance) |
| DCNO | Deputy Chief of Naval Operations |
| DCNO(MP&T) | Deputy Chief of Naval Operations (Manpower, Personnel and Training) |
| DCNO(PP&O) | Deputy Chief of Naval Operations (Plans, Policy and Operations) |
| DCP | Decision Coordinating Paper |
| DCR | Design Certification Review |
| DDT&E | Director, Defense Test and Evaluation |
| DEPSECDEF | Deputy Secretary of Defense |
| DFARDS | DOD Federal Acquisition Regulation Supplement |
| DG | Defense Guidance |
| DID | Data Item Description |
| DLA | Defense Logistics Agency |
| DMSO | Director, Major Staff Office |
| DNA | Defense Nuclear Agency |
| DNPP | Director of Navy Plans and Programs |
| DNSARC | Department of the Navy System Acquisition Review Council |
| DOD | Department of Defense |
| DODD | Department of Defense Directive |
| DODI | Department of Defense Instruction |
| DON | Department of the Navy |
| DONPIC | DON Program Information Center |
| DOP | Development Options Paper |
| D(PA&E) | Director, Program Analysis and Evaluation |
| DPM | Deputy Program Manager |
| DRB | Defense Resources Board |
| DRRB | Data Requirements Review Board |
| DSARC | Defense Systems Acquisition Review Council |
| DSD | Deputy Secretary of Defense |
| DSMC | Defense Systems Management College |
| DT | Development Test |
| DTC | Design-To-Cost |
| DT&E | Development Test and Evaluation |
| DTNSRDC | David W. Taylor Naval Ship Research and Development Center |
| DUSD(PR) | Deputy Under Secretary of Defense for Policy Review |
| DUSN(FM) | Deputy Under Secretary of the Navy, Financial Management |

E

| | |
|------|------------------------------------|
| EAC | Estimated Cost at Completion |
| ECP | Engineering Change Proposal |
| ECCM | Electronic Counter-Countermeasures |
| ECM | Electronic Countermeasures |
| ECR | Embedded Computer Resource |

-E-
(continued)

| | |
|------|--|
| EDCD | Environmental Design Criteria Document |
| EDM | Engineering Development Model |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| EMP | Electromagnetic Pulse |
| EMSP | Enhanced Modular Signal Processor |
| EPA | Extended Planning Annex |
| ESM | Electronic Support Measure |
| EPR | Environmental Profile Report |

F

| | |
|-------|---|
| FACI | First-Article Configuration Inspection |
| FAI | Federal Acquisition Institute |
| FAR | Federal Acquisition Regulation |
| FAT | Factory Acceptance Test |
| FCA | Functional Configuration Audit |
| FCRC | Federal Contract Research Center |
| FFP | Firm Fixed Price |
| FIP | Functional Implementation Plan |
| FMP | Fleet Modernization Program |
| FMS | Foreign Military Sales |
| FOM | Figure of Merit |
| FOT&E | Follow-on Operational Test and Evaluation |
| FPEA | Fixed-Price with Economic Adjustment |
| FPIF | Fixed-Price Incentive Fee |
| FPR | Fixed-Price Redetermination |
| FPIS | Fixed-Price Incentive, Successive Targets |
| FSD | Full-Scale Development (Phase) |
| FTTS | Factory-To-Target Sequence |
| FYDP | Five-Year Defense Program |

G

| | |
|-----|----------------------------------|
| G&A | General and Administrative |
| GAT | Government Acceptance Test |
| GFE | Government-Furnished Equipment |
| GFI | Government-Furnished Information |
| GFM | Government-Furnished Material |

H

| | |
|---------|---------------------------------|
| HARDMAN | Hardware Manpower |
| HDBK | Handbook |
| HEL | High-Energy Laser |
| HLT | Hardware Lead Time |
| HME | Hull, Mechanical and Electrical |
| HQMC | Headquarters, Marine Corps |

I

| | |
|-------|---|
| ILS | Integrated Logistics Support |
| ILSP | Integrated Logistics Support Plan |
| IMET | International Military Education and Training |
| IOC | Initial Operational Capability |
| IOT&E | Initial Operational Test and Evaluation |
| IPR | In-Progress Review |
| IPS | Integrated Program Summary |
| IR | Infrared |
| IR&D | Independent Research and Development |

J

| | |
|-------|--|
| JCS | Joint Chiefs of Staff |
| JMSNS | Justification for Major System New Start |
| JPAM | Joint Program Assessment Memorandum |
| JSPD | Joint Strategic Planning Document |
| JT&E | Joint Service Test and Evaluation |

L

| | |
|------|--------------------------------------|
| LCC | Life-Cycle Cost |
| LLTP | Long Lead Time Procurement |
| LM | Logistics Manager |
| LMTC | Logistics Management Training Center |
| LOE | Level Of Effort |
| LORA | Level Of Repair Analysis |
| LP | Life Profile |
| LRG | Logistics Review Group |
| LSA | Logistics Support Analysis |

M

| | |
|--------|--|
| MASM | Military Assistance and Sales Manual |
| MCDEC | Marine Corps Development and Education Center |
| MCO | Marine Corps Order |
| MCORD | Marine Corps Order |
| MCOTEA | Marine Corps Operational Test and Evaluation Agency |
| MDCS | Maintenance Data Collection System |
| MEWS | Minimum Essential Weapon System |
| MILCON | Military Construction |
| MIP | Navy RDT&E Management Information Paper |
| MIS | Mission Information System |
| MMMS | Maintenance and Material Management System (3M System) |
| MND | Mission Need Determination |
| MOA | Memorandum Of Agreement |
| MOU | Memorandum Of Understanding |
| MP | Mission Profile |
| MPM | Milestone Planning Meeting |
| MPS | Merit Pay System |
| MP&TS | Manpower, Personnel, and Training Systems |

M
(continued)

| | |
|-------|-----------------------------------|
| MRB | Material Review Board |
| MRD | Milestone Review Documentation |
| MST&E | Multi-Service Test and Evaluation |
| MTBF | Mean-Time-Between-Failure |
| MTTR | Mean-Time-To-Repair |

N

| | |
|----------|---|
| NAC | Naval Avionics Center |
| NADC | Naval Air Development Center |
| NAE | Naval Acquisition Executive |
| NAEC | Naval Air Engineering Center |
| NAESU | Naval Air Engineering Service Unit |
| NAPC | Naval Air Propulsion Center |
| NAR | Navy Acquisition Requirement |
| NARSUP | Navy Acquisition Regulation Supplement |
| NSPE | Navy Senior Procurement Executive |
| NATC | Naval Air Test Center |
| NATO | North Atlantic Treaty Organization |
| NAVAIR | Naval Air Systems Command |
| NAVCOMPT | Comptroller of the Navy |
| NAVELEX | Naval Electronics Systems Command |
| NAVMAT | Naval Material Command, Headquarters |
| NAVPRO | Naval Plant Representative Office |
| NAVSEA | Naval Sea Systems Command |
| NAVSUP | Naval Supply Systems Command |
| NCEL | Naval Civil Engineering Laboratory |
| NCSC | Naval Coastal Systems Center |
| NDCP | Naval Decision Coordinating Paper |
| NMC | Naval Material Command |
| NNPP | Naval Nuclear Propulsion Program |
| NORDA | Naval Ocean Research and Development Activity |
| NOSC | Naval Ocean Systems Center |
| NOS | Naval Ordnance Station |
| NPRDC | Naval Personnel Research and Development Center |
| NRL | Naval Research Laboratory |
| NSATS | NAVMAT Selected Acquisition Tracking System |
| NSTEP | Naval Scientist Training and Education Program |
| NSWC | Naval Surface Weapons Center |
| NTE | Navy Technical Evaluation |
| NTEC | Naval Training and Equipment Center |
| NTP | Naval Training Plan |
| NUSC | Naval Underwater Systems Center |
| NWC | Naval Weapons Center |
| NWEF | Naval Weapons Engineering Facility |
| NWSC/C | Naval Weapons Support Center, Crane |

O

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| OCEANAV | Oceanographer of the Navy |
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| OJCS | Organization of the Joint Chiefs of Staff |
| OMB | Office of Management and Budget |
| OPEVAL | Operational Evaluation |
| OPNAV | Office of Chief of Naval Operations |
| OPTEVFOR | Operational Test and Evaluation Force |
| OR | Operational Requirement |
| OS | Ocean Surveillance |
| OSD | Office of the Secretary of Defense |
| OT&E | Operational Test and Evaluation |

P

| | |
|------------|---|
| P3I (PPPI) | Preplanned Product Improvement |
| PAT&E | Production Acceptance Test and Evaluation |
| PBD | Program Budgeting Decision |
| PC | Program Coordinator |
| PCA | Physical Configuration Audit |
| PCO | Procuring Contracting Officer |
| PDA | Program Decision Authority |
| PDM | Program Decision Memorandum |
| PDR | Preliminary Design Review |
| PDS | Program Decision Set |
| PERT | Program Evaluation and Review Technique |
| PHST | Packaging, Handling, Storage, Transportation |
| PIP | Product Improvement Program |
| PL | Public Law |
| PM | Program Manager |
| PMO | Program Management Office or Organization |
| PMP | Program Management Proposal |
| PMT | Production Monitoring Test |
| PMTC | Pacific Missile Test Center |
| POM | Program Objective Memorandum |
| PPBS | Planning, Programming, Budgeting System |
| PPM | Preproduction Prototype Model |
| PRDR | Preproduction Reliability Design Review |
| PRESINSURV | President of the Board of Inspection and Survey |
| PRO | Plant Representative Office |
| PSD | Program Summary Document |
| PSO | Program Support Office |

Q

| | |
|----|-------------------|
| QA | Quality Assurance |
| QC | Quality Control |

R

| | |
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| RAD | Resource Allocation Display |
| RAN | Request for Authority to Negotiate |

-R-
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| | |
|-------|---|
| RCS | Radar Cross Section |
| R&D | Research and Development |
| RDT&E | Research, Development, Test and Evaluation |
| RD | Requirement Document |
| RFP | Request For Proposal |
| RFQ | Request For Quotation |
| R&M | Reliability and Maintainability |
| RM&A | Reliability, Maintainability, and Availability |
| ROC | Required Operational Capability |
| RPV | Remotely Piloted Vehicle |
| RSI | Rationalization, Standardization and Interoperability |

S

| | |
|--------|--|
| SAR | Selected Acquisition Report |
| SCIB | Ship Characteristics and Improvement Board |
| SCP | System Concept Paper |
| SDDM | SECDEF Decision Memorandum |
| SECDEF | Secretary of Defense |
| SECNAV | Secretary of the Navy |
| SEM | Standard Equipment Module |
| SEMP | System Engineering Management Program |
| SES | Senior Executive Service |
| SMI | Ship Manpower Information |
| SMD | Ship Manpower Document |
| SNDM | SECNAV Decision Memorandum |
| SOW | Statement Of Work |
| SPP | Sponsor Program Proposal |
| SQMD | Squadron Manpower Document |
| SSA | Source Selection Authority |
| SSC | Source Selection Council |
| SSEB | Source Selection Evaluation Board |
| SSPK | Single-Shot Probability of Kill |
| SSPO | Strategic Systems Project Office |
| SSPP | System Safety Program Plan |
| SUP | Service-Use-Profile |
| SYSCOM | Systems Command |

T

| | |
|----------|---|
| TAAF | Test, Analyze, and Fix |
| TADSTAND | Tactical Digital Standards |
| TDP | Technical Data Package |
| T&E | Test and Evaluation |
| TECHEVAL | Technical Evaluation |
| TECPO | Tactical Embedded Computer Program Office |
| TEMP | Test and Evaluation Master Plan |
| TM | Technical Manager |
| TOR | Tentative Operational Requirement |
| TPS | Tentative Program Summary |

-T-
(continued)

TRACE Total Risk Assessment Cost Estimate

U

UPC Unit Procurement Cost
USD(P) Under Secretary of Defense (Policy)
USD(R&E) Under Secretary of Defense (Research and Engineering)
USDR&E Under Secretary of Defense for Research and Engineering

V

VERT Venture Evaluation and Review Technique

W

WBS Work Breakdown Structure
WSES RB Weapons Systems Explosive Safety Review Board
WSIG Weapons System Improvement Group

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